

Chapter 2

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**Chapter
2****Transformations**

Dear Family,

Photo albums record our most precious memories—and can last for generations. It can take a lot of creativity to make a great family album. One of the keys to designing the album is to use photos and text in a variety of sizes and positions.

You and your student may want to work together on a family album. While working, you might think about some of the following possibilities.

- Move your photos around on the page—don't position every photo in the same way. In mathematics, this is called a *translation* of the image—and it's a simple way to add interest to your pages.
- Try rotating your photos—not every photo has to be straight on the page. Rotate some photos so that they are on an angle.
- Sometimes a photo works better when you use its reflection. For example, digital photos can be “flipped” so that a person faces in another direction. This can make the composition more pleasing, but use this with care—it can make people look a bit different and any written words in the photo will appear backwards.
- Try different sizes for the text and rotate the position of the text. A good rule of thumb is to use three fonts or less on a page.
- Remember to leave some space around the photos and text. A page with too much on it will look cluttered. Try to figure out a proportion of covered to uncovered space on the page that looks good.

Computers have simplified the task of making family albums, but don't be afraid to work on paper—it's still a great way to work on a project together.

Show the album to your family and friends—they are sure to enjoy it!

**Capítulo
2****Transformaciones**

Estimada Familia:

Los álbumes de fotos registran nuestras memorias más preciadas—y pueden durar por generaciones. Se requiere de mucha creatividad para hacer un álbum familiar increíble. Una de las claves para diseñar el álbum es usar fotos y texto en una variedad de tamaños y posiciones.

Usted y su estudiante querrán trabajar juntos en un álbum familiar. Al trabajar, pueden pensar acerca de algunas de las siguientes posibilidades:

- Muevan las fotos por toda la página—no coloquen cada foto del mismo modo. En matemáticas, esto se conoce como *traslación* de la imagen—y es un modo simple de añadir interés a sus páginas.
- Intenten rotando las fotos—no todas las fotos tienen que estar derechas en la página. Roten algunas fotos para que queden en ángulo.
- A veces una foto funciona mejor cuando se usa su reflejo. Por ejemplo, las fotos digitales pueden voltearse para que la persona mire hacia el otro lado. Esto puede hacer que la composición sea más agradable, pero háganlo con cuidado—la gente puede verse algo distinta y cualquier palabra que aparezca en la foto se verá escrita al revés.
- Intenten con distintos tamaños para el texto y roten la posición del texto. Una regla muy importante es usar tres tipos de letra o menos en cada página.
- Recuerden dejar algo de espacio alrededor de las fotos y el texto. Una página que contenga mucho de esto se verá demasiado llena. Intenten averiguar una proporción de espacio cubierto y sin cubrir en la página que se vea bien.

Las computadoras han simplificado la tarea de hacer álbumes familiares, pero no tengan miedo de trabajar en papel—aún sigue siendo una gran manera de trabajar todos juntos en un proyecto.

Muestren el álbum a sus familiares y amigos—¡les va a encantar!

Activity
2.1**Start Thinking!**

For use before Activity 2.1

Draw two triangles that are:

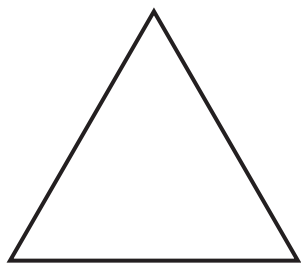
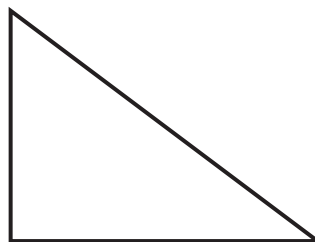
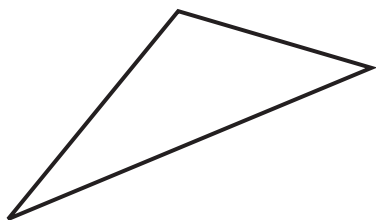
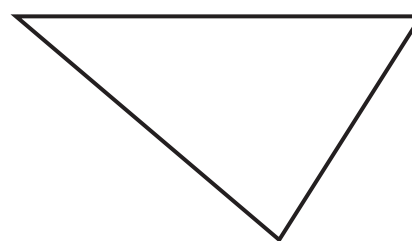
1. the same shape and size.
2. the same shape but *not* the same size.
3. *not* the same shape and *not* the same size.

Which pair of triangles do you think are called *congruent triangles*? Why?

Activity
2.1**Warm Up**

For use before Activity 2.1

Copy the triangle and use a ruler to measure each side.

1.**2.****3.****4.**

Lesson
2.1

Start Thinking!

For use before Lesson 2.1

With a partner, discuss the questions below. Be sure to support your answers.

1. Is it possible for two triangles to have the same angle measures but not be congruent?
2. Is it possible for two triangles to have the same side lengths but not be congruent?

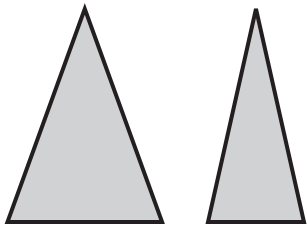
Lesson
2.1

Warm Up

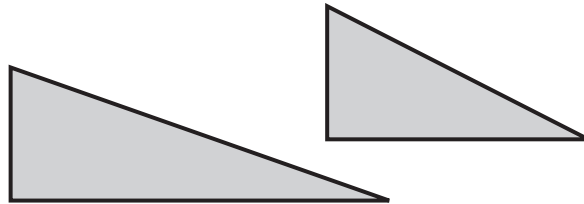
For use before Lesson 2.1

Tell whether the triangles are *congruent* or *not congruent*.

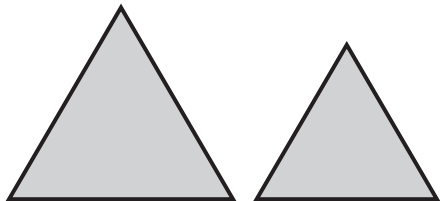
1.



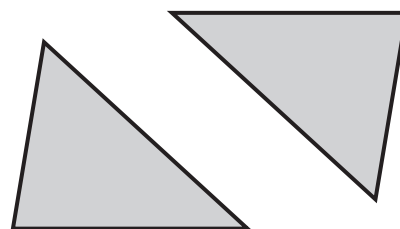
2.



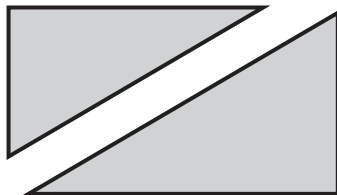
3.



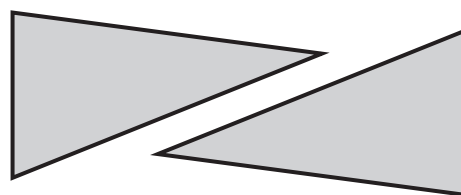
4.



5.

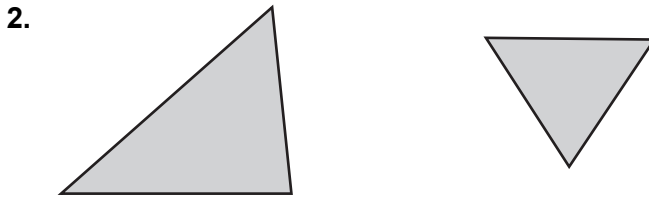
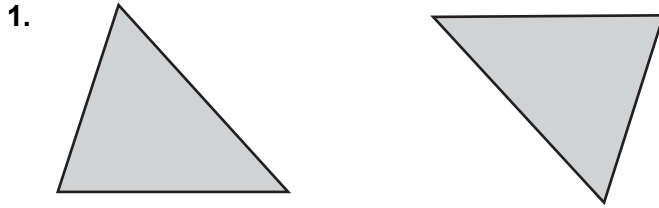


6.

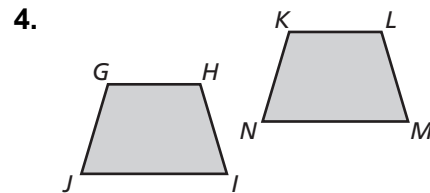
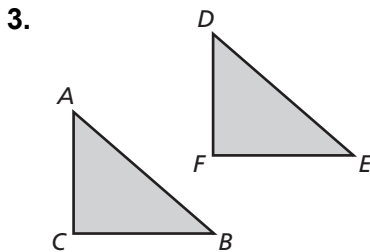


2.1 Practice A

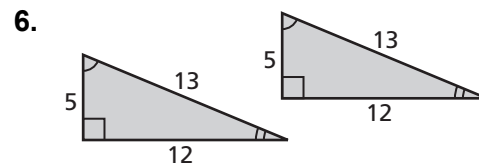
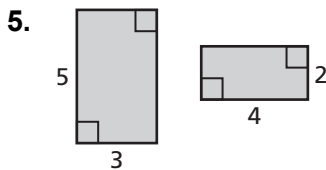
Tell whether the triangles are *congruent* or *not congruent*.



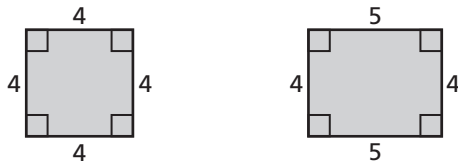
The figures are congruent. Name the corresponding angles and the corresponding sides.



Tell whether the two figures are congruent. Explain your reasoning.



7. Describe and correct the error in telling whether the two figures are congruent.



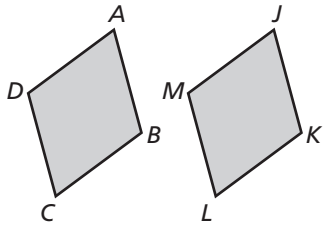
Both figures have four sides and corresponding angle measures are equal. So, they are congruent.

8. Can two polygons be congruent if one has a right angle and the other does not? Explain.

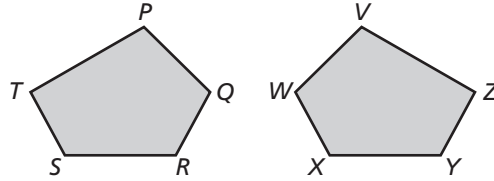
2.1 Practice B

The figures are congruent. Name the corresponding angles and the corresponding sides.

1.

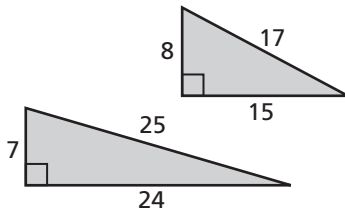


2.

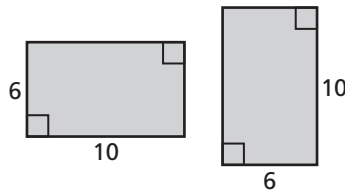


Tell whether the two figures are congruent. Explain your reasoning.

3.

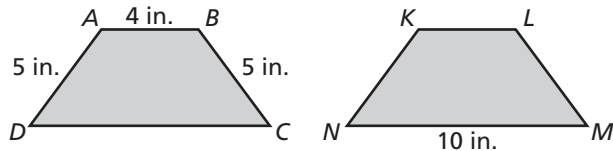


4.



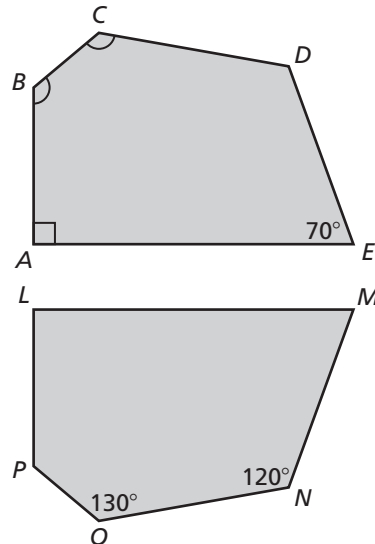
5. The figures are congruent.

- What is the length of side CD ?
- Which angle of $KLMN$ corresponds to $\angle B$?
- What is the perimeter of $ABCD$?



6. The pentagons are congruent. Determine whether the statement is *true* or *false*. Explain your reasoning.

- $\angle B$ is congruent to $\angle C$.
- Side MN is congruent to side AE .
- $\angle B$ corresponds to $\angle O$.
- Side BC is congruent to side PO .
- The sum of the angle measures of $LMNOP$ is 540° .
- The measure of $\angle B$ is 120° .



2.1 Enrichment and Extension

Perimeter and Area of Similar Figures

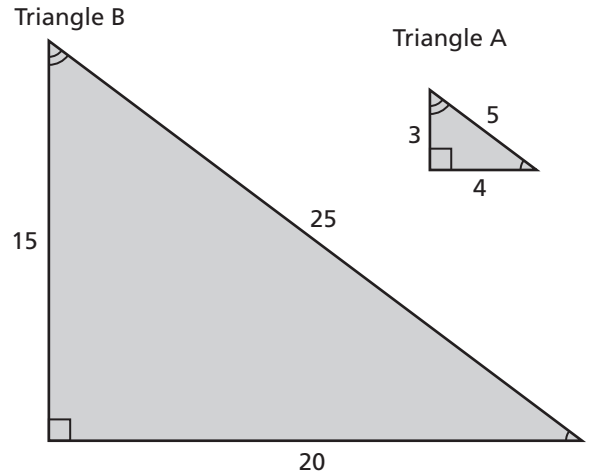
The triangles shown are similar. Use the given information to draw conclusions about the relationship between similar figures, their areas, and their perimeters.

In Exercises 1–8, use the figure.

1. What is the relationship between the side lengths of Triangle A and Triangle B?
2. Find the perimeter of Triangle A.
3. Find the perimeter of Triangle B.
4. What is the relationship between the perimeter of Triangle A and the perimeter of Triangle B? How did you predict this relationship?
5. Find the area of Triangle A.
6. Find the area of Triangle B.
7. What is the relationship between the area of Triangle B and the area of Triangle A?
8. Area is a two-dimensional measurement. How did you predict this relationship?

In Exercises 9 and 10, use the relationships you discovered above.

9. Rectangle A has a width of 2 centimeters. Rectangle B has a width of 6 centimeters. Rectangle A has an area of 18 square centimeters. Rectangle A is similar to Rectangle B. What is the area of Rectangle B?
10. Would the relationship you discovered still apply if the two shapes were not similar? Explain your reasoning.



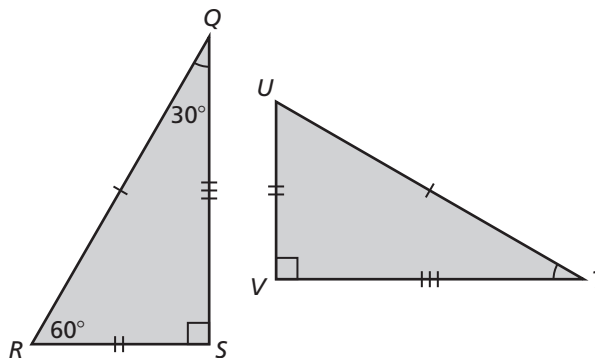
2.1 Puzzle Time

What Is A Lion's Favorite Food?

Circle the letter of each correct answer in the boxes below. The circled letters will spell out the answer to the riddle.

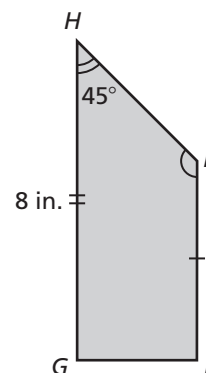
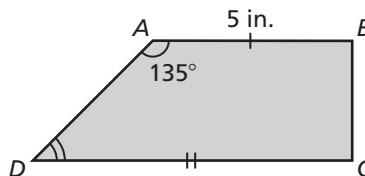
In Exercises 1–5, use the figure.

- What side of TUV corresponds to side QS ?
- What side of QRS corresponds to side UV ?
- What angle of TUV corresponds to $\angle R$?
- What angle of QRS corresponds to $\angle V$?
- What is the measure of $\angle U$?



In Exercises 6–11, use the figure.

- What side of $EFGH$ corresponds to side BC ?
- What angle of $EFGH$ corresponds to $\angle C$?
- What is the length of side CD ?
- What is the length of side EF ?
- What is the measure of $\angle D$?
- What is the measure of $\angle E$?



B	R	A	L	O	K	T	E	S	M	D	R
60°	13 in.	side TV	$\angle T$	side BC	135°	$\angle Q$	$\angle U$	side GH	30°	side FG	180°
O	B	T	E	W	C	I	H	N	G	P	S
side QR	$\angle S$	$\angle E$	8 in.	90°	side EF	45°	$\angle H$	side RS	5 in.	side UV	$\angle G$

Activity
2.2**Start Thinking!**

For use before Activity 2.2

Discuss with a partner careers that use the concept of scale drawings.

Activity
2.2**Warm Up**

For use before Activity 2.2

Plot each point in a coordinate plane.

1. $N(-3, 2)$

2. $P(0, -2)$

3. $Q(1, 4)$

4. $R(2, 0)$

5. $S(-4, 0)$

6. $T(-1, -3)$

**Lesson
2.2****Start Thinking!**

For use before Lesson 2.2

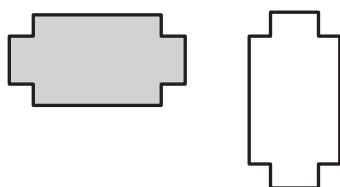
Give an example of a translation you could find in your home that is also a tessellation. Explain how it is a translation.

**Lesson
2.2****Warm Up**

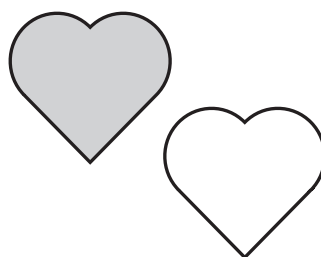
For use before Lesson 2.2

Tell whether the shaded figure is a translation of the nonshaded figure.

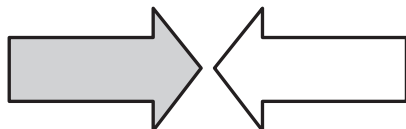
1.



2.



3.



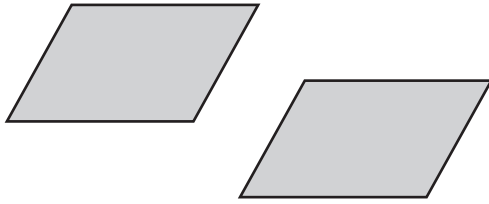
4.



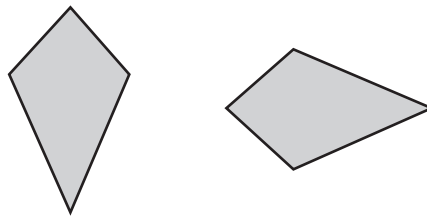
2.2 Practice A

Tell whether the right figure is a translation of the left figure.

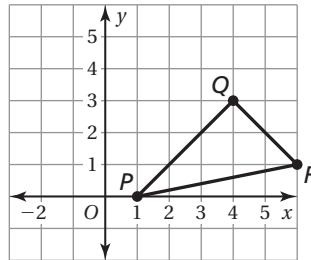
1.



2.

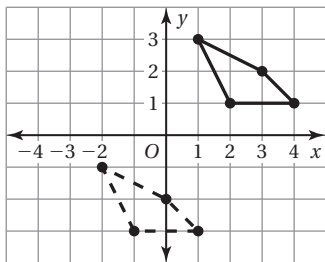


3. Translate the triangle 3 units left and 2 units up. What are the coordinates of the image?



The vertices of a triangle are $A(-2, 0)$, $B(0, 3)$, and $C(2, 2)$. Draw the figure and its image after the translation.

4. 4 units down
5. 2 units right and 1 unit up
6. Describe the translation from the solid line figure to the dashed line figure.

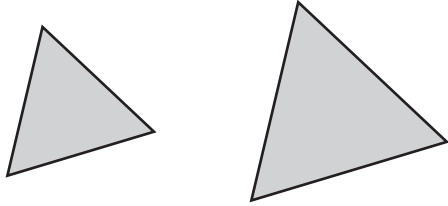


7. In Exercise 6, describe the translation from the dashed line figure to the solid line figure.

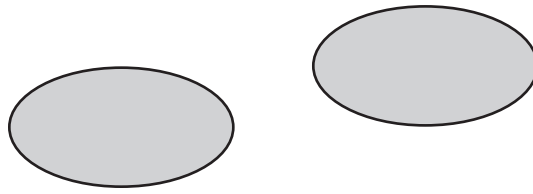
2.2 Practice B

Tell whether the right figure is a translation of the left figure.

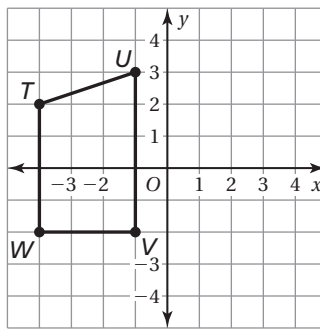
1.



2.



3. Translate the figure 5 units right and 1 unit up. What are the coordinates of the image?



Describe the translation of the point to its image.

4. $(1, 5) \rightarrow (-1, 1)$
5. $(-2, -3) \rightarrow (-2, 4)$
6. A square is translated 3 units left and 5 units down. Then the image is translated 4 units right and 2 units down.
 - a. Describe the translation of the original square to the ending position.
 - b. Describe the translation of the ending position to the original square.
7. You rearrange your bedroom. Tell whether each move is an example of a translation.
 - a. You slide your bed 1 foot along the wall.
 - b. You move your desk and chair to the opposite wall.
 - c. You move your bed stand to the other side of the bed.

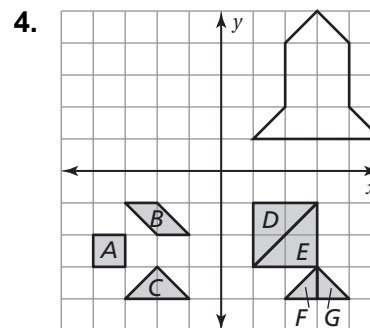
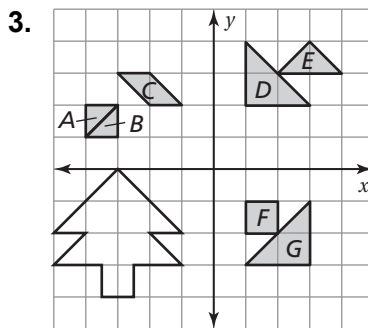
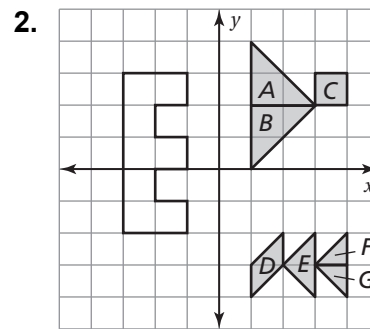
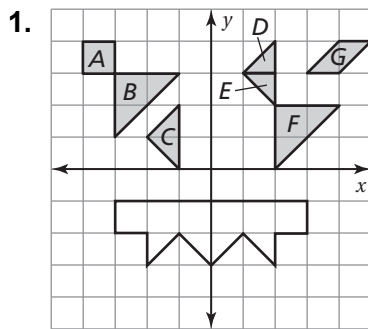
2.2 Enrichment and Extension

Tangrams and Translations

Tangram puzzles are believed to be ancient in origin but were first published in the early 1800s in China. The goal of a tangram puzzle is to arrange seven smaller shapes, called tans, without overlapping, to form the tangram shape. Your challenge is to create the tangram shapes below by translating the tans that appear on the same coordinate plane.

Describe a translation for each tan so that they fill the tangram outline.

Find both possible sets of translations for Exercise 3.



- There are two ways to make the tangram in Exercise 4. Find the other way.
- Make your own tangram puzzle and describe the translations necessary to create it. Then give your puzzle to a friend and compare his or her translations with yours. Are they the same? Do they give the same result? Explain.



Puzzle Time

What Is There More Of The Less You See?

Write the letter of each answer in the box containing the exercise number.

Translate the point as indicated to find its image.

1. $(1, 2)$

2 units right and 4 units up

2. $(-1, -1)$

3 units right and 3 units down

3. $(-4, 5)$

4 units left and 1 unit up

4. $(4, -6)$

8 units left and 7 units up

5. $(-2, -3)$

6 units left and 5 units down

6. $(14, 23)$

20 units left and 15 units down

7. $(-6, -19)$

12 units right and 17 units up

8. $(-13, 9)$

18 units right and 8 units down

Answers

K. $(6, -2)$

S. $(3, 6)$

D. $(5, 1)$

E. $(-4, 1)$

N. $(-8, -8)$

R. $(2, -4)$

A. $(-8, 6)$

S. $(-6, 8)$

8	3	2	7	5	4	1	6
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Activity
2.3**Start Thinking!**

For use before Activity 2.3

Explain how flying in an airplane is a translation.

Activity
2.3**Warm Up**

For use before Activity 2.3

The vertices of a triangle are $A(-4, 4)$, $B(-4, 1)$, and $C(-1, 1)$. Draw the figure and its image after the translation.

1. 6 units right
2. 1 unit left and 3 units down

Lesson
2.3

Start Thinking!

For use before Lesson 2.3

Words like “racecar” and “deed” are known as palindromes. What are some other examples of palindromes? Are palindromes reflections? Explain.

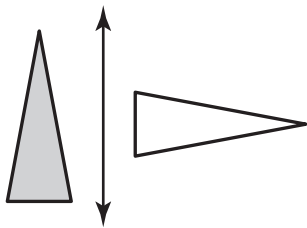
Lesson
2.3

Warm Up

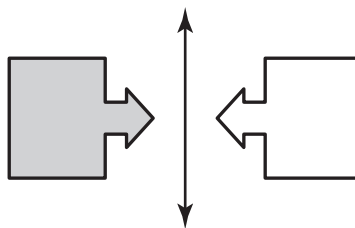
For use before Lesson 2.3

Tell whether the shaded figure is a reflection of the nonshaded figure.

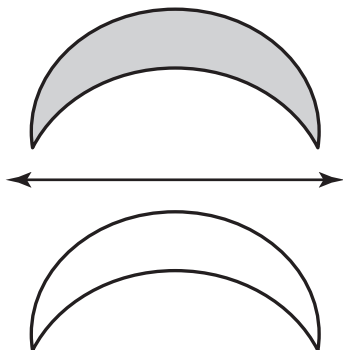
1.



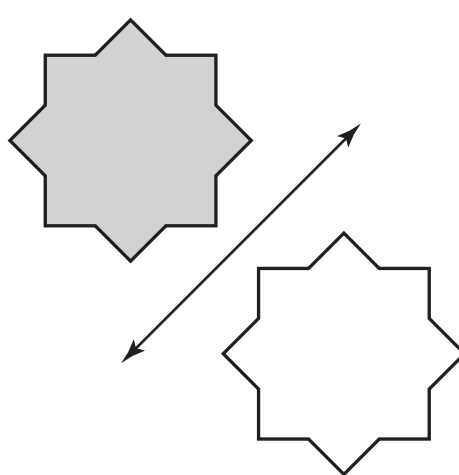
2.



3.



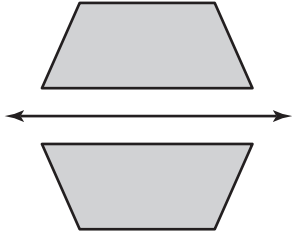
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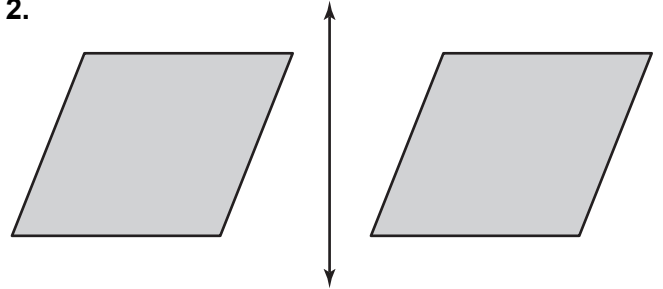
2.3 Practice A

Tell whether one figure is a reflection of the other figure.

1.



2.



Draw the figure and its reflection in the x -axis. Identify the coordinates of the image.

3. $E(0, 2), F(3, 1), G(4, 3)$

4. $H(-3, 2), I(-1, 5), J(2, 1)$

Draw the figure and its reflection in the y -axis. Identify the coordinates of the image.

5. $X(0, -1), Y(2, 3), Z(4, -2)$

6. $U(-5, 1), V(-4, -2), W(-2, 0)$

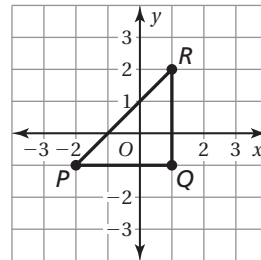
7. What does the word MOM spell when it is reflected in a horizontal line?

The coordinates of a point and its image are given. Is the reflection in the x -axis or y -axis?

8. $(-5, 2) \rightarrow (5, 2)$

9. $(4, 3) \rightarrow (4, -3)$

10. Translate the triangle 2 units left and 1 unit up. Then reflect the image in the x -axis. Graph the resulting triangle.

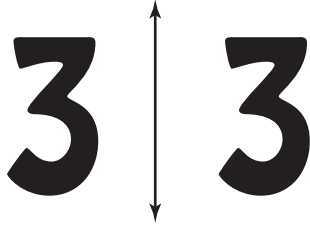


11. A figure is in Quadrant IV. The figure is reflected in the y -axis. In which quadrant is the image?

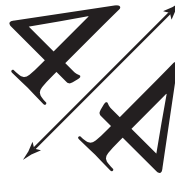
2.3 Practice B

Tell whether one figure is a reflection of the other figure.

1.



2.



Draw the figure and its reflection in the x -axis. Identify the coordinates of the image.

3. $K(-3, 3)$, $L(-2, 1)$, $M(1, 2)$, $N(2, 5)$ 4. $O(-2, -1)$, $P(-1, -3)$, $Q(1, -4)$, $R(3, -1)$

Draw the figure and its reflection in the y -axis. Identify the coordinates of the image.

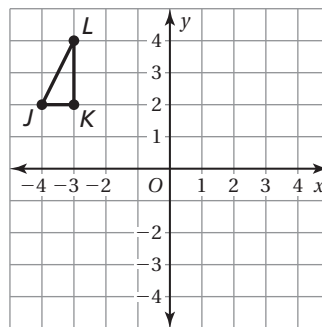
5. $B(2, -3)$, $C(3, 1)$, $D(5, 3)$, $E(3, 0)$ 6. $G(-5, -5)$, $H(-3, -1)$, $I(-2, 4)$, $J(-1, -1)$

7. What does the word “pop” spell when it is reflected in a horizontal line?

The coordinates of a point and its image are given. Is the reflection in the x -axis or y -axis?

8. $(0, 3) \rightarrow (0, -3)$ 9. $(1, 5) \rightarrow (-1, 5)$

10. Reflect the triangle in the x -axis. Then reflect the image in the y -axis. Graph the resulting triangle.

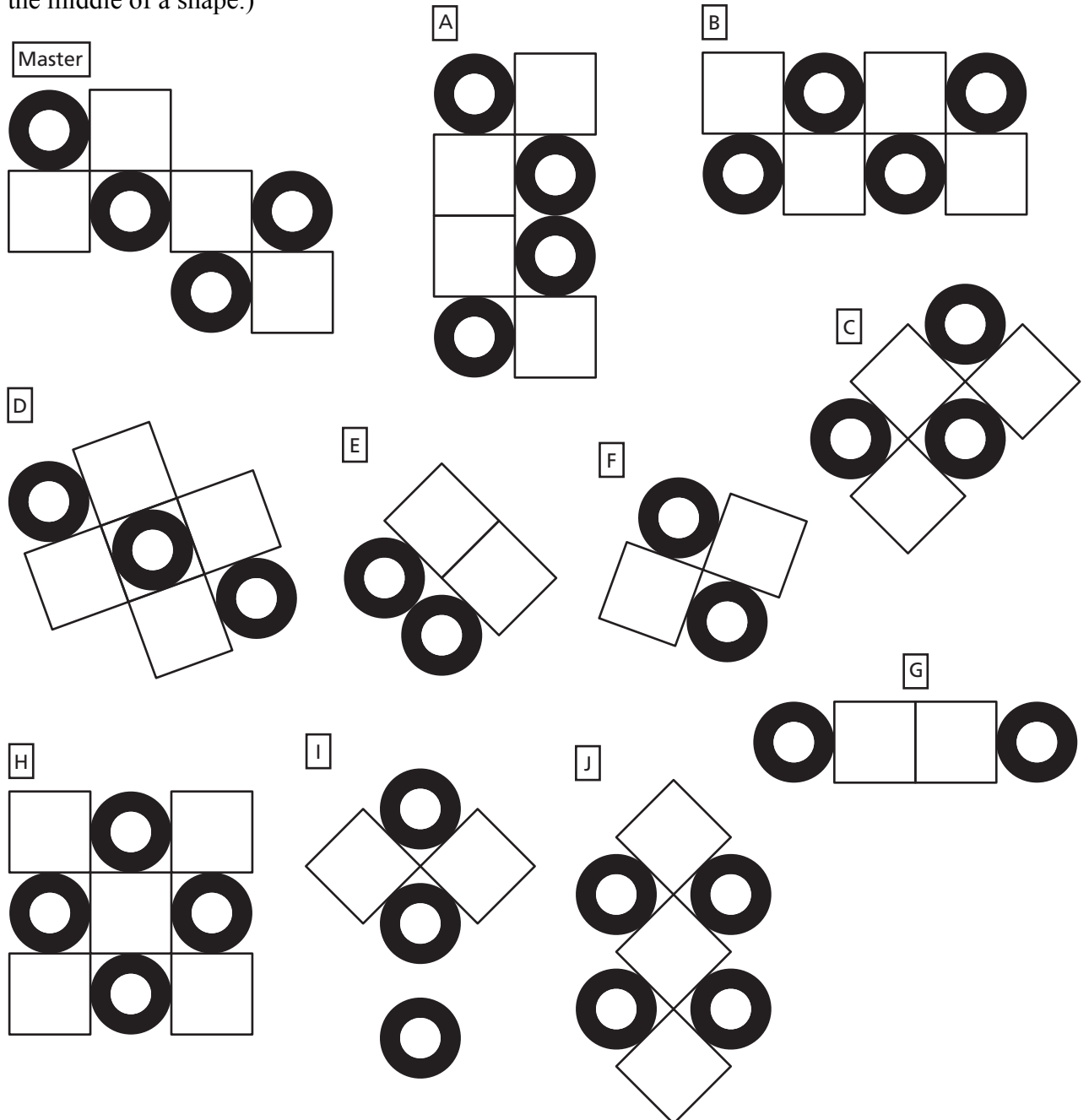


11. $\triangle ABC$ has vertices $A(-2, -1)$, $B(4, 2)$, $C(2, -2)$.
- Reflect $\triangle ABC$ in the x -axis. Then reflect $\triangle A'B'C'$ in the y -axis. What are the coordinates of the resulting triangle?
 - How are the x - and y -coordinates of the resulting triangle related to the x - and y -coordinates of $\triangle ABC$?

2.3 Enrichment and Extension

Mirror Mirror On the Wall...

Some of the following figures are created by reflecting part of the Master over an imaginary line of reflection. Some of the figures cannot be created using this method. Determine whether the figures can be created using the Master. For those that can be created, draw a diagram showing the part of the Master and the imaginary line that were used. (*Hints:* The Master can be turned before being reflected. The line can go through the middle of a shape.)





Puzzle Time

What Kind Of Coat Can You Put On Only When It's Wet?

Write the letter of each answer in the box containing the exercise number.

Reflect the point in the x -axis. Identify the coordinates of the image.

1. $(2, 5)$

2. $(-3, 7)$

R. $(-2, -5)$ **S.** $(-2, 5)$ **T.** $(2, -5)$ **A.** $(-3, -7)$ **B.** $(3, 7)$ **C.** $(3, -7)$

3. $(-4, -12)$

4. $(13, -8)$

D. $(4, -12)$ **E.** $(4, 12)$ **F.** $(-4, 12)$ **M.** $(-13, 8)$ **N.** $(13, 8)$ **O.** $(-13, -8)$

Reflect the point in the y -axis. Identify the coordinates of the image.

5. $(7, -6)$

6. $(9, 5)$

O. $(-7, -6)$ **P.** $(-7, 6)$ **Q.** $(7, 6)$ **H.** $(9, -5)$ **I.** $(-9, 5)$ **J.** $(-9, -5)$

7. $(-15, -12)$

8. $(-23, 8)$

A. $(15, -12)$ **B.** $(15, 12)$ **C.** $(-15, 12)$ **M.** $(23, -8)$ **N.** $(-23, -8)$ **O.** $(23, 8)$

The coordinates of a point and its image are given. Is the reflection in the x -axis, y -axis, or neither?

9. $(11, 7) \rightarrow (11, -7)$

10. $(-4, -5) \rightarrow (4, -5)$

A. x -axis **B.** y -axis **C.** neither **B.** x -axis **C.** y -axis **D.** neither

11. $(-8, 8) \rightarrow (8, -8)$

12. $(53, -26) \rightarrow (-53, -26)$

R. x -axis **S.** y -axis **T.** neither **O.** x -axis **P.** y -axis **Q.** neither

2		10	5	7	1		8	3		12	9	6	4	11
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**Activity
2.4****Start Thinking!**

For use before Activity 2.4

Does a football field have a line of reflection?
Explain.

**Activity
2.4****Warm Up**

For use before Activity 2.4

Find the coordinates of the figure after reflecting in the x -axis.

1. $D(-5, -4)$, $E(-5, -2)$, $F(-1, -2)$, $G(-1, -4)$
2. $H(2, 1)$, $I(2, 5)$, $J(4, 4)$, $K(4, 2)$

Lesson
2.4

Start Thinking!

For use before Lesson 2.4

Give an example of a translation, reflection, and rotation in a basketball game.

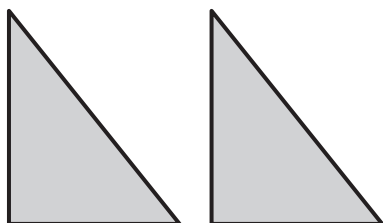
Lesson
2.4

Warm Up

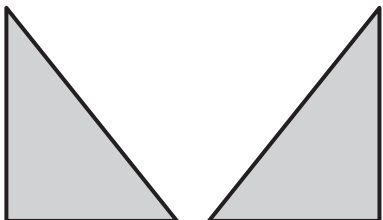
For use before Lesson 2.4

Identify the transformation.

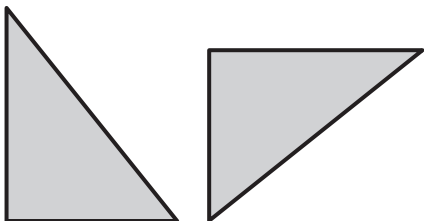
1.



2.

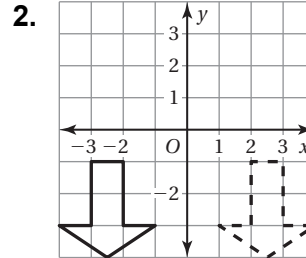
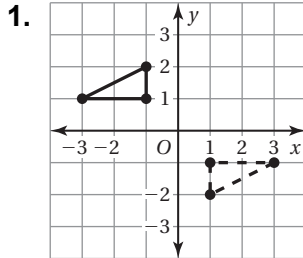


3.



2.4 Practice A

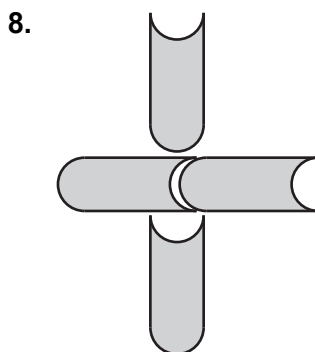
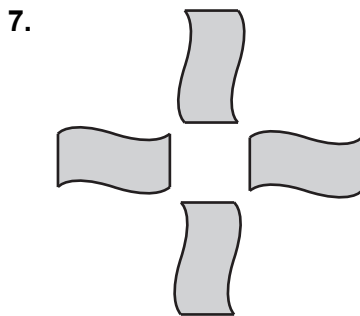
Tell whether the dashed figure is a rotation of the solid figure about the origin. If so, give the angle and direction of rotation.



The vertices of a triangle are $A(-4, 1)$, $B(-2, 2)$, and $C(-1, 1)$. Rotate the triangle as described. Find the coordinates of the image.

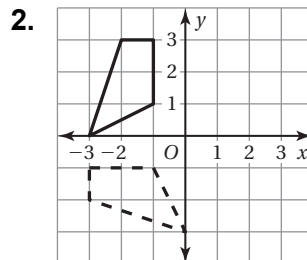
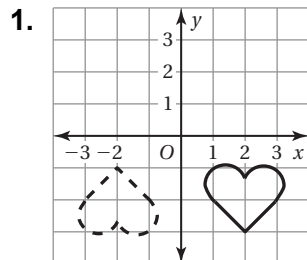
3. 270° clockwise about the origin
4. 90° counterclockwise about the origin
5. 90° counterclockwise about vertex A
6. 180° about vertex C

Tell whether the figure has rotational symmetry.



2.4 Practice B

Tell whether the dashed figure is a rotation of the solid figure about the origin. If so, give the angle and direction of rotation.

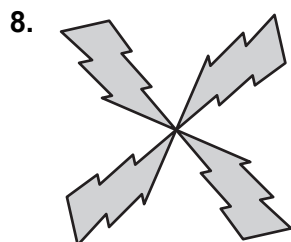
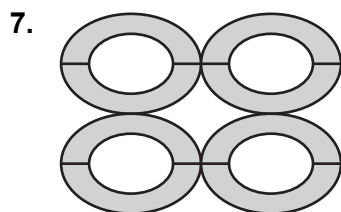


The vertices of a trapezoid are $A(1, 1)$, $B(2, 2)$, $C(4, 2)$, and $D(5, 1)$.

Rotate the trapezoid as described. Find the coordinates of the image.

3. 90° clockwise about the origin
4. 270° counterclockwise about the origin
5. 90° clockwise about vertex A
6. 180° about vertex D

Tell whether the figure has rotational symmetry.

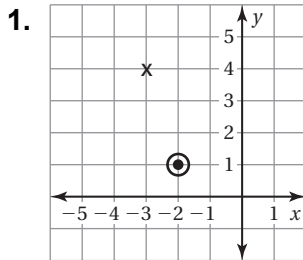


2.4 Enrichment and Extension

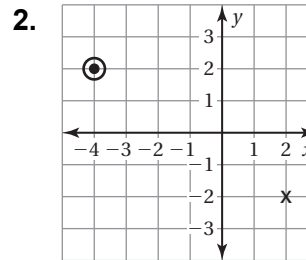
Help Save the Lost Animals

You are part of a lost animal search and rescue team. Because of the treacherous terrain, you often have to go way out of the way and do some back-tracking in order to locate animals. Not only that, but the navigation equipment keeps mixing up the signals and getting the directions out of order. Your job is to look at the map and put the steps in order.

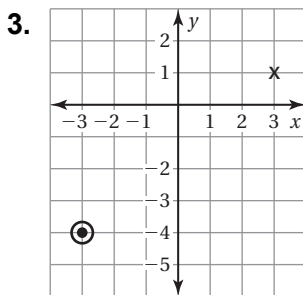
For each situation, the transformations will lead the rescue team to the animal, but they are not in the correct order. Find the correct order. Use each transformation exactly once. In each situation, you start out at the “x,” and the animal that you are trying to rescue is located at the bull’s eye.



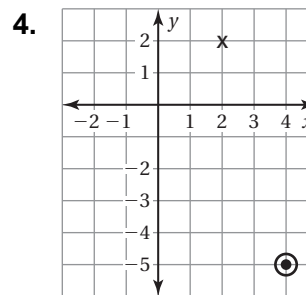
- Translate 2 units left and 2 units up.
- Rotate 90° clockwise about the origin.
- Reflect in the x -axis.
- Rotate 180° about the origin.



- Translate 1 unit right.
- Rotate 90° counterclockwise about the origin.
- Rotate 180° about the origin.
- Translate 3 units down.
- Reflect in the y -axis.



- Reflect in the x -axis.
- Translate 3 units down.
- Reflect in the y -axis.
- Rotate 90° clockwise about the origin.
- Rotate 90° counterclockwise about the origin.



- Rotate 90° counterclockwise about the origin.
- Rotate 180° about the origin.
- Translate 3 units left.
- Translate 2 units up.
- Reflect in the x -axis.
- Reflect in the y -axis.



Puzzle Time

What Jam Can't You Eat?

Write the letter of each answer in the box containing the exercise number.

The vertices of a triangle are $A(2, 3)$, $B(7, 4)$, and $C(6, 1)$. Rotate the triangle as described. Find the coordinates of the image.

1. 90° clockwise about the origin
2. 180° about the origin
3. 90° counterclockwise about the origin
4. 180° about vertex A

The vertices of a triangle are $D(3, 4)$, $E(3, 1)$, and $F(1, 1)$. Rotate the triangle as described. Find the coordinates of the image.

5. 180° about the origin
6. 90° clockwise about vertex D
7. 90° clockwise about vertex E
8. 90° clockwise about vertex F

The vertices of a parallelogram are $W(-6, 3)$, $X(-4, 4)$, $Y(-2, 2)$, and $Z(-4, 1)$. Rotate the parallelogram as described. Find the coordinates of the image.

9. 90° clockwise about the origin
10. 90° counterclockwise about the origin
11. 180° about the origin

10		4	11	7	1	5	9	2		8	3	6
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Answers for Exercises 1–4

- A. $A'(-3, 2)$, $B'(-4, 7)$, $C'(-1, 6)$
- F. $A'(3, -2)$, $B'(4, -7)$, $C'(1, -6)$
- C. $A'(-2, -3)$, $B'(-7, -4)$,
 $C'(-6, -1)$
- T. $A'(2, 3)$, $B'(-3, 2)$, $C'(-2, 5)$

Answers for Exercises 5–8

- F. $D'(-3, -4)$, $E'(-3, -1)$,
 $F'(-1, -1)$
- J. $D'(4, -1)$, $E'(1, -1)$, $F'(1, 1)$
- M. $D'(3, 4)$, $E'(0, 4)$, $F'(0, 6)$
- A. $D'(6, 1)$, $E'(3, 1)$, $F'(3, 3)$

Answers for Exercises 9–11

- R. $W'(6, -3)$, $X'(4, -4)$,
 $Y'(2, -2)$, $Z'(4, -1)$
- A. $W'(-3, -6)$, $X'(-4, -4)$,
 $Y'(-2, -2)$, $Z'(-1, -4)$
- I. $W'(3, 6)$, $X'(4, 4)$, $Y'(2, 2)$,
 $Z'(1, 4)$

Activity
2.5**Start Thinking!**

For use before Activity 2.5

How can you use proportions to help plant a garden?

Activity
2.5**Warm Up**

For use before Activity 2.5

Tell whether the ratios form a proportion.

1. $\frac{2}{5}, \frac{10}{25}$

2. $\frac{7}{14}, \frac{21}{28}$

3. $\frac{12}{21}, \frac{15}{30}$

4. $\frac{15}{24}, \frac{35}{36}$

5. $\frac{6}{8}, \frac{15}{20}$

6. $\frac{36}{8}, \frac{63}{14}$

Lesson
2.5

Start Thinking!

For use before Lesson 2.5

Explain how to determine if two figures are similar.

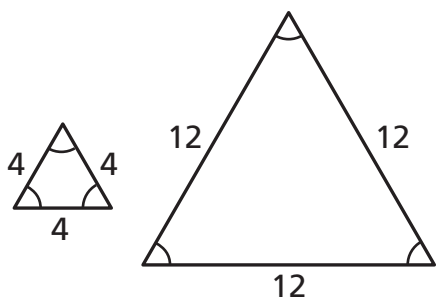
Lesson
2.5

Warm Up

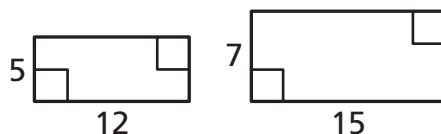
For use before Lesson 2.5

Tell whether the two figures are similar.
Explain your reasoning.

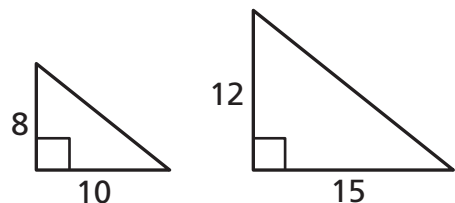
1.



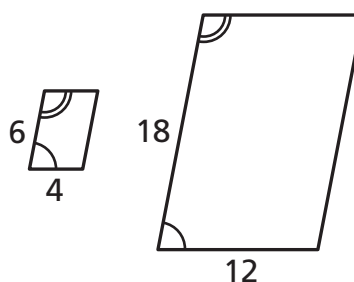
2.



3.

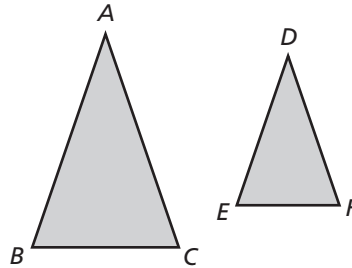


4.

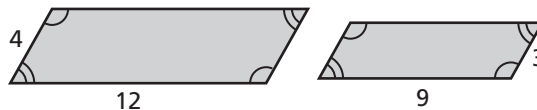


2.5 Practice A

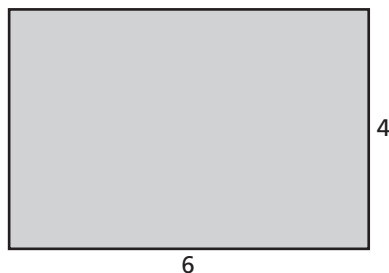
1. Name the corresponding angles and the corresponding sides of the similar figures.



2. Tell whether the two figures are similar. Explain your reasoning.



3. The rectangular traffic sign is 18 inches wide and 8 inches tall. The rectangular realtor sign is 27 inches wide and 10 inches tall. Are the signs similar?
4. The given rectangle needs to be modified.



- a. Each side length is increased by 2.
Is the new rectangle similar to the original?
- b. Each side length is increased by 50%.
Is the new rectangle similar to the original?
5. Which of the following card dimensions are similar rectangles?
- | | |
|----------------|------------------|
| 2 in. by 5 in. | 3 in. by 6 in. |
| 1 in. by 3 in. | 1 in. by 2.5 in. |

2.5 Practice B

1. In a coordinate plane, draw the figures with the given vertices. Which figures are similar? Explain your reasoning.

Rectangle A: $(0, 0)$, $(3, 0)$, $(3, 2)$, $(0, 2)$

Rectangle B: $(0, 0)$, $(1, 0)$, $(1, 3)$, $(0, 3)$

Rectangle C: $(0, 0)$, $(2, 0)$, $(2, -3)$, $(0, -3)$

2. A rectangular index card is 6 inches long and 4 inches wide. A rectangular note card is 1.5 inches long and 1 inch wide. Are the cards similar?
3. Given $\triangle PQR \sim \triangle TUV$. Name the corresponding angles and the corresponding sides.

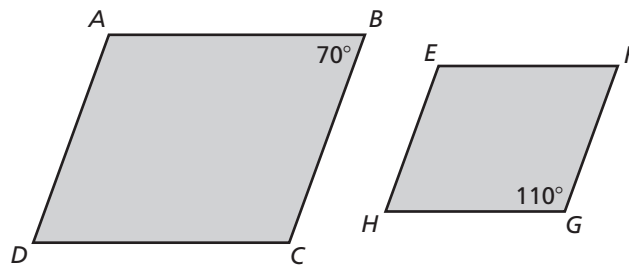
The two parallelograms are similar. Find the degree measure of the angle.

4. $\angle A$

5. $\angle H$

6. $\angle D$

7. $\angle F$



8. Is it possible for the following figures to be similar? Explain.
- A stop sign and a speed limit sign
 - A cell phone and a test paper
 - A yield sign and a home plate
 - A laptop and a swimming pool
9. Can you draw two triangles each having two 45° angles and one 90° angle that are *not* similar? Justify your answer.
10. You have a triangle that has side lengths of 6, 9, and 12.
- Give the side lengths of a similar triangle that is smaller than the given triangle.
 - Give the side lengths of a similar triangle that is larger than the given triangle.
 - Each side length is increased by 30%. Is the new triangle similar to the original?

2.5 Enrichment and Extension

You Be the Video Game Designer!

Some video game designers use coordinate planes to identify the location of players and obstacles in the playing field. Imagine that you are creating a video game in which the player can use a laser to shrink and enlarge objects. Because the laser simply changes the size of the object but does not distort its shape, you will be creating similar figures.

List the coordinates of the points of the enlarged and shrunken objects. When you are enlarging an object, keep point A stationary. When you are shrinking an object, keep point B stationary. All coordinates should be listed as whole numbers or fractions. (Hint: You may want to graph the points and draw the objects on graph paper.)

1. Describe a situation in a video game in which a laser might be used to enlarge or shrink an object.
2. A triangle has vertices $A(1, 4)$, $B(1, 1)$, and $C(5, 1)$.
 - a. Enlarge: Multiply the lengths of the sides of the original triangle by 3.
 - b. Shrink: Multiply the lengths of the sides of the original triangle by $\frac{2}{3}$.
3. A house has vertices $A(0, 3)$, $B(3, 0)$, $C(2, 0)$, $D(2, -3)$, $E(-2, -3)$, $F(-2, 0)$, and $G(-3, 0)$.
 - a. Enlarge: Multiply the lengths of the sides of the original house by $1\frac{1}{2}$.
 - b. Shrink: Multiply the lengths of the sides of the original house by $\frac{1}{3}$.
4. A star has vertices $A(-2, 1)$, $B(-3, -1)$, $C(-5, -1)$, $D\left(-3\frac{1}{2}, -2\frac{1}{2}\right)$, $E(-4, -5)$, $F\left(-2, -3\frac{1}{2}\right)$, $G(0, -5)$, $H\left(-\frac{1}{2}, -2\frac{1}{2}\right)$, $I(1, -1)$, and $J(-1, -1)$.
 - a. Enlarge: Multiply the lengths of the sides of the original star by 5.
 - b. Shrink: Multiply the lengths of the sides of the original star by $\frac{1}{2}$.
5. How many times larger is the area of the enlarged triangle compared to the area of the original triangle? Why do you think this is the case?

2.5 Puzzle Time

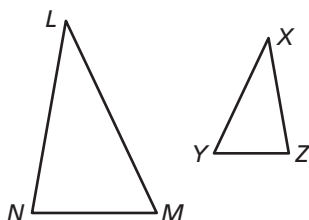
Did You Hear About...

A	B	C	D	E	F
G	H	I	J	K	

Complete each exercise. Find the answer in the answer column. Write the word under the answer in the box containing the exercise letter.

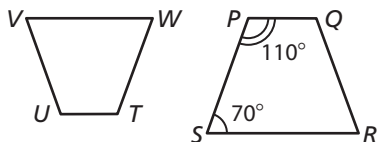
side LM ALWAYS
side YZ FALLING
side PR CAR
90° UNDER
$\angle X$ THE
$\angle L$ FLAT
$\angle M$ WHEELS
60° FOR
side XY KEPT
side PQ HOW
side VW TWO
70° IT

In Exercises A–F, use the two similar triangles.



- What is $\angle L$'s corresponding angle?
- What is $\angle M$'s corresponding angle?
- What is $\angle N$'s corresponding angle?
- What is side LM 's corresponding side?
- What is side MN 's corresponding side?
- What is side LN 's corresponding side?

In Exercises G–K, use the two similar trapezoids.



- What is the measure of $\angle T$?
- What is the measure of $\angle W$?
- What is side PQ 's corresponding side?
- What is side RS 's corresponding side?
- What is side QR 's corresponding side?

80° EVER
$\angle Y$ BICYCLE
side MN PEDALS
$\angle Z$ THAT
side PS THEY'RE
110° BECAUSE
side UV TIRED
side LN SO
$\angle N$ WERE
180° WHO
side XZ OVER
side TU WAS

Activity
2.6**Start Thinking!**

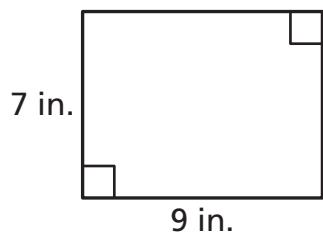
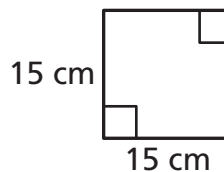
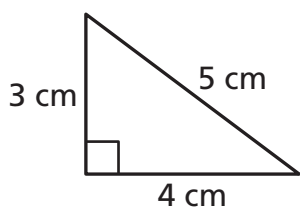
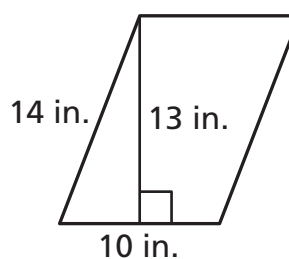
For use before Activity 2.6

You want to put new carpet in your room. How do you make sure you buy enough carpet?

Activity
2.6**Warm Up**

For use before Activity 2.6

Find the perimeter and area.

1.**2.****3.****4.**

**Lesson
2.6****Start Thinking!**

For use before Lesson 2.6

Your neighbor wants to replace his rectangular deck with one that is double the side lengths. Use what you have learned in Activity 2.6 to explain to your neighbor what will happen to the perimeter of the deck.

**Lesson
2.6****Warm Up**

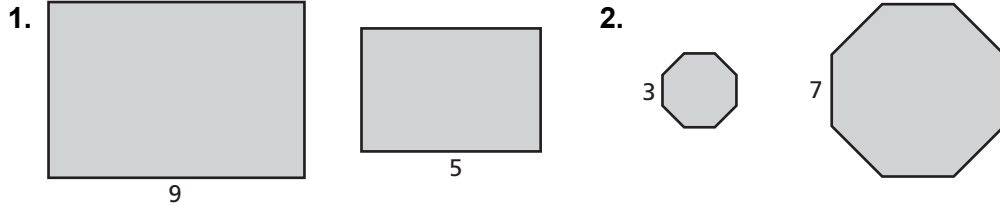
For use before Lesson 2.6

Complete the following exercises.

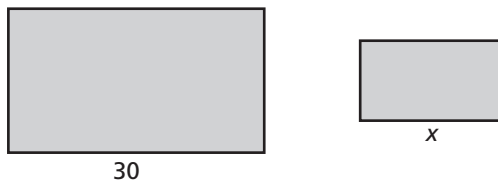
1. How does quadrupling the side lengths of a triangle affect its perimeter?
2. How does doubling the base of a triangle affect its area?
3. How does tripling the side lengths of a rectangle affect its perimeter?
4. How does doubling the side lengths of a parallelogram affect its perimeter?

2.6 Practice A

The two figures are similar. Find the ratio (small to large) of the perimeters and of the areas.



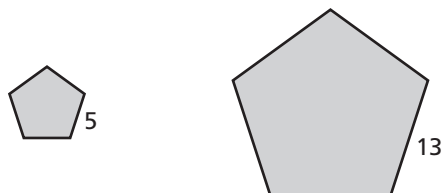
3. How does doubling the side lengths of a triangle affect its area?
4. The ratio of the corresponding side lengths of two similar rectangular tables is 4 : 5.
- What is the ratio of the perimeters?
 - What is the ratio of the areas?
 - The perimeter of the larger table is 44 feet. What is the perimeter of the smaller table?
5. The figures are similar. The ratio of the perimeters is 5 : 9. Find x .



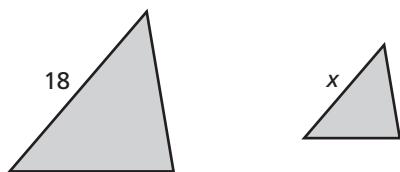
6. The ratio of the area of Triangle A to Triangle B is 16 : 49. Triangle A is similar to Triangle B .
- Which triangle is larger, A or B ?
 - A side length of Triangle B is 3.5 inches. What is the corresponding side length of Triangle A ?
 - What is the ratio of the perimeter of Triangle A to the perimeter of Triangle B ?
 - The side lengths of Triangle A are increased by 40%. The side lengths of Triangle B do not change. What is the new ratio of the area of Triangle A to Triangle B ?

2.6 Practice B

1. The two figures are similar. Find the ratio (small to large) of the perimeters and of the areas.



2. How does tripling the side lengths of a pentagon affect its perimeter?
3. The figures are similar. The ratio of the perimeters is $12 : 7$. Find x .

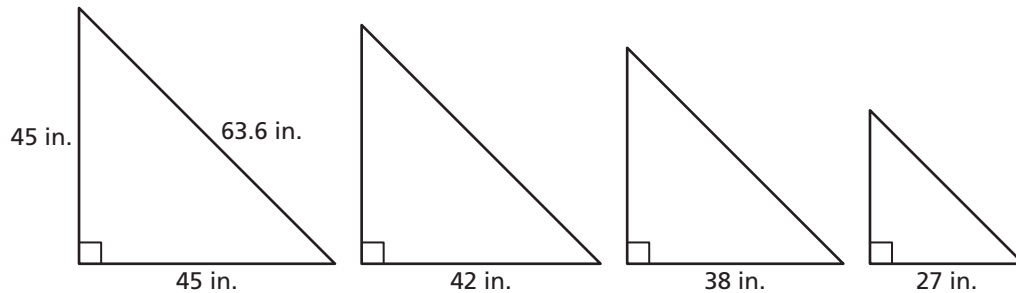


4. The ratio of the corresponding side lengths of two similar parallelogram signs is $9 : 14$.
- What is the ratio of the perimeters?
 - What is the ratio of the areas?
 - One side length of the smaller sign is 45 feet. What is the side length of the corresponding side of the larger sign?
5. A window is put in a door. The window and the door are similar rectangles. The door has a width of 4 feet. The window has a width of 30 inches.
- How many times greater is the area of the door than the area of the window?
 - The area of the door is 32 square feet. What is the area of the window?
 - What is the perimeter of the window?
6. The area of Circle P is 4π . The area of Circle Q is 25π .
- What is the ratio of their areas?
 - What is the ratio of their radii?
 - The radius of Circle Q is decreased by 50%. What is the new circumference of Circle Q?

2.6 Enrichment and Extension

Getting an Art Project Covered

Alicia is starting an art project. Her first step is to cover the frames below with canvas and put ribbon around all the edges. All of the frames are similar figures. Help her decide how much material and ribbon to buy.



1. Ribbon costs \$2.27 per yard and is sold to the nearest inch. What is the least that the ribbon will cost for all the frames?
2. Canvas is sold in rolls that are 45 inches wide. On the rectangle below, draw the best way for Alicia to arrange the 4 triangles in order to waste the least amount of material. Be sure to label each triangle. What is the least length of material (to the nearest inch) that she can buy and still have enough to cover all the triangles?



3. The canvas costs \$3.99 per yard. What is the least that the material will cost?
4. How much material will she use?
5. How much material will she have left over?
6. What percent of the material will be left over? Round to the nearest whole percent.
7. Why do you think stores sell material this way?
8. What are some ways that Alicia could use the left over material?



Puzzle Time

Where Do Stinging Insects Go When They're Sick?

Write the letter of each answer in the box containing the exercise number.

In Exercises 1–7, use the following information.

An Olympic size swimming pool is 25 meters wide and 50 meters long. A similar pool that is smaller is 12 meters wide.

1. What is the ratio of the perimeters of the pools?
2. What is the ratio of the areas of the pools?
3. What is the perimeter of the Olympic size pool?
4. What is the perimeter of the smaller pool?
5. What is the area of the Olympic size pool?
6. What is the area of the smaller pool?
7. What is the length of the smaller pool?

Answers

- | | |
|--|---------------------|
| H. 24 m | O. 625 : 144 |
| W. $10\frac{2}{3}$ in. ² | T. 3 : 4 |
| T. 9 in. | S. 9 : 16 |
| T. 1250 m ² | I. 150 m |
| A. 288 m ² | L. 72 m |
| E. 2 in. | P. 12 in. |
| A. 25 : 12 | |

In Exercises 8–13, use the following information.

A hexagon on a small soccer ball has a side length of $1\frac{1}{2}$ inches. The ratio of the side length of the hexagon to the side lengths of a hexagon from a larger soccer ball is 3 : 4.

8. What is the ratio of the perimeters of the hexagons?
9. What is the ratio of the areas of the hexagons?
10. What is the perimeter of the smaller hexagon?
11. What is the perimeter of the larger hexagon?
12. What is the side length of the larger hexagon?
13. The area of the smaller hexagon is about 6 square inches. What is the area of the larger hexagon?

5	2		8	7	12		13	6	9	11	3	10	1	4
---	---	--	---	---	----	--	----	---	---	----	---	----	---	---

Activity
2.7**Start Thinking!**

For use before Activity 2.7

Discuss with a partner real-life objects that can be enlarged or reduced.

Activity
2.7**Warm Up**

For use before Activity 2.7

Multiply.

1. $2 \bullet 4$

2. $-5 \bullet 4$

3. $-6 \bullet 0.5$

4. $-3 \bullet 0.5$

5. $8 \bullet \frac{1}{4}$

6. $16 \bullet \frac{1}{4}$

Lesson
2.7**Start Thinking!**

For use before Lesson 2.7

Describe why it is important for a photographer to know how to enlarge and reduce photos.

Lesson
2.7**Warm Up**

For use before Lesson 2.7

Draw the triangle with the given vertices. Multiply each coordinate of the vertices by 3 and then draw the new triangle. How are the two triangles related?

- 1. $(0, 3), (3, 3), (3, -1)$**
- 2. $(0, -1), (0, 4), (3, 4)$**

2.7 Practice A

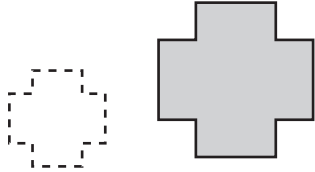
Draw the triangle with the given vertices. Multiply each coordinate of the vertices by 3 and then draw the new triangle. How are the two triangles related?

1. $(0, 0), (1, 3), (2, 1)$

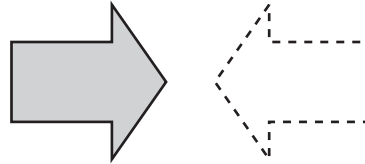
2. $(-3, -2), (-1, 4), (2, -2)$

Tell whether the dashed figure is a dilation of the solid figure.

3.



4.



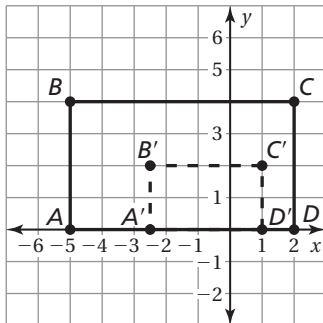
The vertices of a figure are given. Draw the figure and its image after a dilation with the given scale factor. Identify the type of dilation.

5. $A(-3, -2), B(2, 4), C(8, 1); k = \frac{1}{4}$

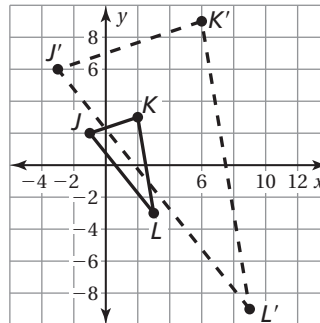
6. $D(1, 2), E(4, 1), F(1, -3), G(-3, -2); k = 5$

The dashed figure is a dilation of the solid figure. Identify the type of dilation and find the scale factor.

7.



8.



9. A triangle is dilated using a scale factor of 4. The image is then dilated using a scale factor of 3. What scale factor could you use to dilate the original triangle to get the final image?

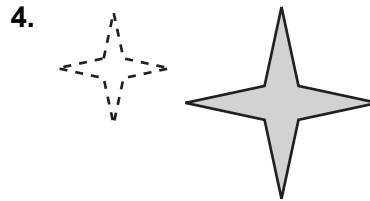
10. The vertices of a figure are $P(1, 2), Q(3, 4),$ and $R(-1, 6)$. Dilate with respect to the origin using a scale factor of 2 and then translate 4 units right and 3 units down. Find the coordinates of the figure after the transformations given.

2.7 Practice B

Draw the triangle with the given vertices. Multiply each coordinate of the vertices by 3 and draw the new triangle. How are the two triangles related?

- $(0, 4), (-1, -3), (5, 2)$
- $(-40, -20), (-20, 30), (40, -10)$

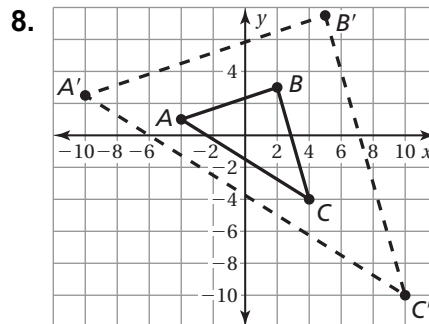
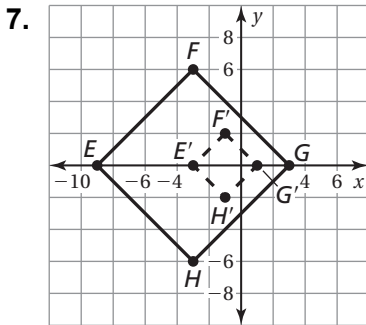
Tell whether the dashed figure is a dilation of the solid figure.



The vertices of a figure are given. Draw the figure and its image after dilation with the given scale factor. Identify the type of dilation.

- $A(3, -1), B(-4, 4), C(-2, -3); k = 5$
- $D(10, 20), E(-35, 10), F(25, -30), G(5, -20); k = \frac{1}{5}$

The dashed figure is a dilation of the solid figure. Identify the type of dilation and find the scale factor.



- A scale factor of 2 is used to find the dilation of a quadrilateral. What is the sum of the angles in the original quadrilateral? What is the sum of the angles after the dilation? What is the difference between the perimeter of the original figure and the perimeter of the image?
- A triangle is dilated using a scale factor of $\frac{1}{2}$. The image is then dilated using a scale factor of $\frac{1}{3}$. What scale factor could you use to dilate the original triangle to get the final image?

2.7 Enrichment and Extension

Surf Shop

Sven has selected a logo for his new surf shop. He has enlisted the help of a local print shop to assist him in creating merchandise to advertise his business by dilating the logo.

Use the logo to answer the questions.

1. Sven asks the owner of the print shop to dilate the logo so that the surf board leans to the left instead of to the right. Can the request be filled? Why or why not? Explain your reasoning.
2. Sven asks the owner of the print shop to dilate the logo so that it can be used in a magazine ad to advertise the shop. The logo needs to be increased using a scale factor of 2.5. What are the new dimensions of the logo?
3. The dimensions of Sven's logo need to be increased by 50% for a flyer. What are the new dimensions of the logo?
4. Sven asks the print shop to increase the size of the logo for posters. He wants the logo for the posters to measure 8 inches wide and 18 inches long.
 - a. Which scale factor should the print shop use in order to create the logo?
 - b. Find the percent increase of the dimensions used to produce the poster logo.
5. Sven asks the print shop to decrease the size of the logo for business cards. He wants the logo for the cards to measure 1 inch wide and 2.25 inches long.
 - a. Which scale factor should the print shop use in order to create the logo?
 - b. Find the percent decrease of the dimensions used to produce the business card logo.
6. The print shop increased the size of the logo so that it can be used on souvenir post cards that will be sold in Sven's Surf Shop. Explain why the new logo is not a dilation of the original.





Puzzle Time

What Do You Call A Surgeon With Eight Arms?

Write the letter of each answer in the box containing the exercise number.

The vertices of a triangle are $A(2, 2)$, $B(2, 5)$, and $C(4, 2)$. Find the coordinates of the image after a dilation with the given scale factor.

1. $k = 2$ 2. $k = 5$ 3. $k = 1\frac{1}{2}$

The vertices of a triangle are $A(-5, 5)$, $B(-2, -5)$, and $C(-2, 0)$. Find the coordinates of the image after a dilation with the given scale factor.

4. $k = \frac{1}{2}$ 5. $k = 0.75$ 6. $k = \frac{1}{5}$

The vertices of a triangle are $A(1, 3)$, $B(7, 3)$, and $C(7, 5)$. The vertices of its image after a dilation are given. Find the scale factor.

7. $A'(4, 12)$, $B'(28, 12)$, $C'(28, 20)$
 8. $A'\left(\frac{1}{6}, \frac{1}{2}\right)$, $B'\left(1\frac{1}{6}, \frac{1}{2}\right)$, $C'\left(1\frac{1}{6}, \frac{5}{6}\right)$
 9. $A'(0.5, 1.5)$, $B'(3.5, 1.5)$, $C'(3.5, 2.5)$

9		3	6	1		5	7	8	2	4
				-						

Answers

- B. $k = \frac{1}{4}$
 D. $A'(3, 3)$, $B'\left(3, 7\frac{1}{2}\right)$, $C'(6, 3)$
 T. $A'(-3.75, 3.75)$, $B'(-1.5, -3.75)$, $C'(-1.5, 0)$
 E. $k = 2$
 C. $A'(4, 4)$, $B'(4, 10)$, $C'(8, 4)$
 O. $k = 4$
 A. $k = 0.5$
 S. $A'\left(-2\frac{1}{2}, 2\frac{1}{2}\right)$, $B'\left(-1, -2\frac{1}{2}\right)$, $C'(-1, 0)$
 F. $k = \frac{1}{7}$
 P. $k = \frac{1}{6}$
 U. $A'(10, 10)$, $B'(10, 25)$, $C'(20, 10)$
 J. $k = 6$
 O. $A'(-1, 1)$, $B'\left(-\frac{2}{5}, -1\right)$, $C'\left(-\frac{2}{5}, 0\right)$
 T. $k = 7$

**Chapter
2****Technology Connection**



For use after Section 2.7

Transformations with Geometry Software

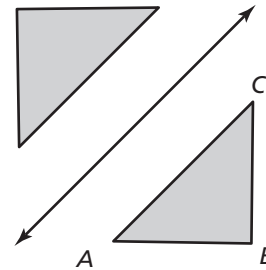
You can use geometry software to perform and explore various transformations.

EXAMPLE How can you perform a reflection of $\triangle ABC$ in a line outside of the triangle?

SOLUTION

Step 1 Use the Segment tool  to create a triangle. Use the  tool to label the vertices A , B , and C .

Step 2 Draw another segment outside of the triangle. Double click on the segment. You should see two squares flash on the segment. This means that you have marked the segment as a line of reflection.



Step 3 Select the triangle. Then go to the TRANSFORM menu and select REFLECT.

Use geometry software to answer each question.

1. What happens to the reflection of $\triangle ABC$ when the line of reflection is moved?
2. Create a new triangle, $\triangle DEF$. Draw a point outside of the triangle and double click on it. Go to the TRANSFORM menu and select DILATE to dilate the triangle. Describe the result.
3. Use the ROTATE command to perform a rotation on $\triangle DEF$. How does moving the center of rotation affect the rotation?