English Spanish

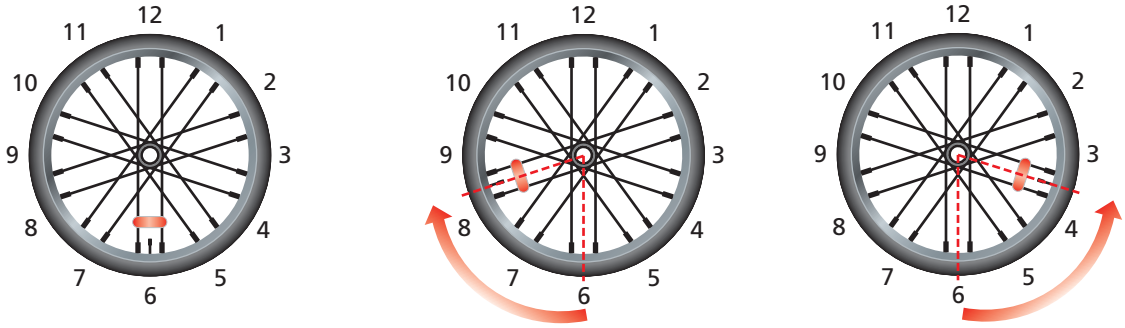
5.7 Rotations

STATE STANDARDS
MA.7.G.4.2

Essential Question What are the three basic ways to move an object in a plane?

The Meaning of a Word Rotate

A bicycle wheel can **rotate** clockwise or counterclockwise.

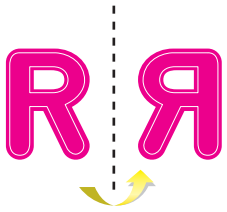


1 ACTIVITY: Three Basic Ways to Move Things

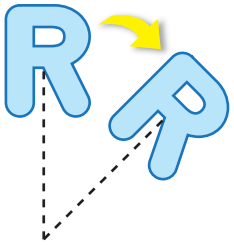
There are three basic ways to move objects on a flat surface.

1. Translate the object.

2. Reflect the object.

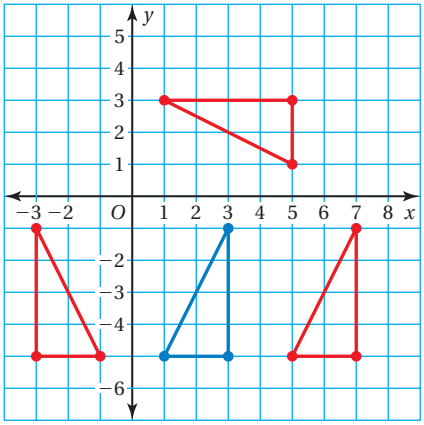


3. Rotate the object.



Work with a partner.

- Cut out a paper triangle that is the same size as the blue triangle shown.
- Decide how you can move the blue triangle to make each red triangle.
- Is each move a *translation*, a *reflection*, or a *rotation*?
- Draw four other red triangles in a coordinate plane. Describe how you can move the blue triangle to make each red triangle.

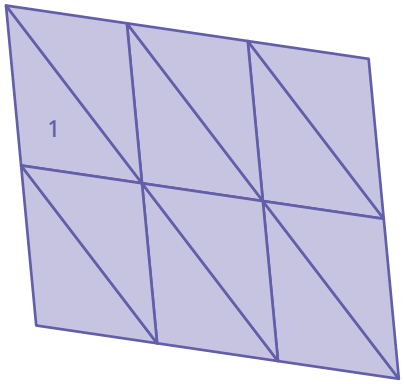


2 ACTIVITY: Tessellating a Plane

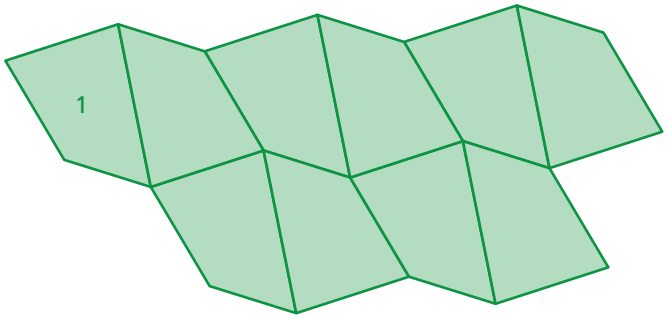
Work with a partner.

a. Describe how the figure labeled 1 in each diagram can be moved to make the other figures.

Triangles



Quadrilaterals



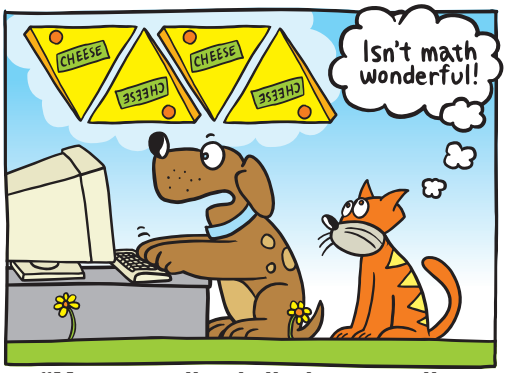
b. **EXPERIMENT** Will *any* triangle tessellate? Conduct an experiment to gather information to help form your conclusion. Draw a triangle. Cut it out. Then use it to trace other triangles so that you cover the plane with triangles that are all the same shape.

c. **EXPERIMENT** Will *any* quadrilateral tessellate? Conduct an experiment to gather information to help form your conclusion. Draw a quadrilateral. Cut it out. Then use it to trace other quadrilaterals so that you cover the plane with quadrilaterals that are all the same shape.

What Is Your Answer?

3. **IN YOUR OWN WORDS** What are the three basic ways to move an object in a plane? Draw an example of each.

"Dear Sub Shop: Why do you put the cheese on the subs so some parts have double coverage and some have none?"



"My suggestion is that you use the tessellation property of triangles for even cheese coverage."

Practice Use what you learned about rotations to complete Exercises 7–9 on page 236.

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5.7 Lesson

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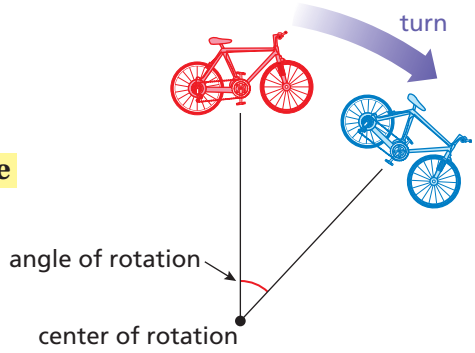
Key Vocabulary
rotation, *p. 234*
center of rotation, *p. 234*
angle of rotation, *p. 234*

Key Idea

Rotations

A **rotation**, or *turn*, is a transformation in which a figure is rotated about a point called the **center of rotation**. The number of degrees a figure rotates is the **angle of rotation**.

The original figure and its image have the same size and shape.

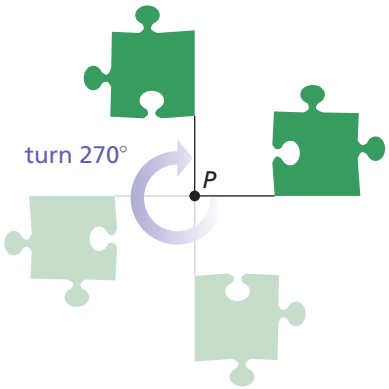


EXAMPLE 1 Standardized Test Practice

You must rotate the puzzle piece 270° clockwise about point *P* to fit it into a puzzle. Which piece fits in the puzzle as shown?

Ⓐ 
Ⓑ 
Ⓒ 
Ⓓ 

Rotate the puzzle piece 270° clockwise about point *P*.



∴ The correct answer is Ⓒ.

Study Tip

When rotating figures, it may help to sketch the rotation in several steps, as shown in Example 1.

On Your Own

Now You're Ready
Exercises 7–12

1. Which piece is a 90° counterclockwise rotation about point *P*?
2. Is choice D a rotation of the original puzzle piece? If not, what kind of transformation does the image show?

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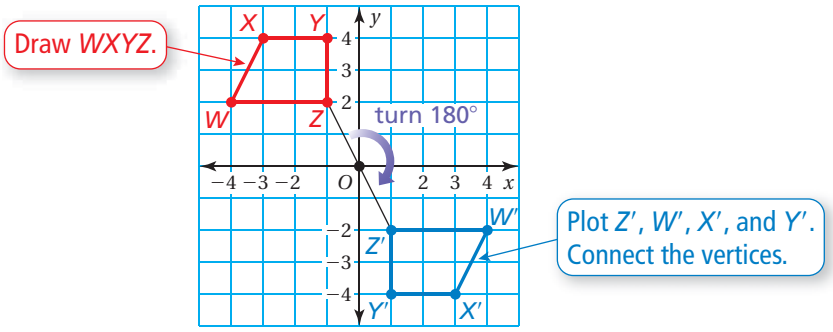
EXAMPLE 2 Rotating a Figure

The vertices of a trapezoid are $W(-4, 2)$, $X(-3, 4)$, $Y(-1, 4)$, and $Z(-1, 2)$. Rotate the trapezoid 180° clockwise about the origin. What are the coordinates of the image?



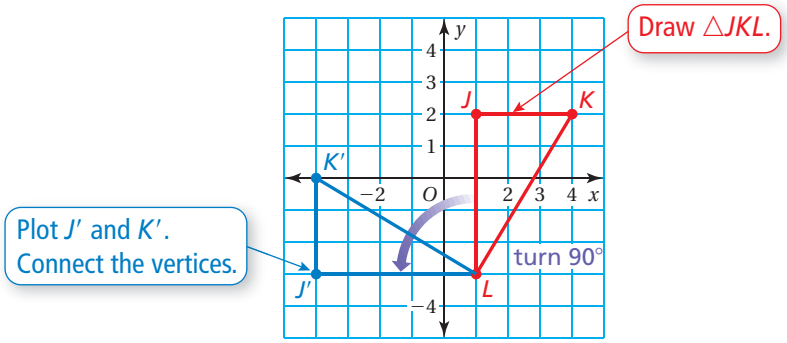
∴ The coordinates of the image are $W'(4, -2)$, $X'(3, -4)$, $Y'(1, -4)$, and $Z'(1, -2)$.

EXAMPLE 3 Rotating a Figure

The vertices of a triangle are $J(1, 2)$, $K(4, 2)$, and $L(1, -3)$. Rotate the triangle 90° counterclockwise about vertex L. What are the coordinates of the image?

Common Error

Be sure to pay attention to whether a rotation is clockwise or counterclockwise.



∴ The coordinates of the image are $J'(-4, -3)$, $K'(-4, 0)$, and $L'(1, -3)$.

On Your Own

Now You're Ready
Exercises 13–16

3. A triangle has vertices $Q(4, 5)$, $R(4, 0)$, and $S(1, 0)$.

a. Rotate the triangle 90° counterclockwise about the origin.

b. Rotate the triangle 180° about vertex S.

c. Are the images in parts (a) and (b) the same size and shape? Explain.

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5.7 Exercises

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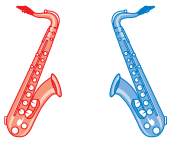
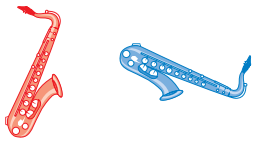
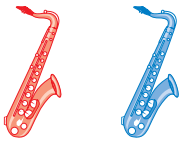
Vocabulary and Concept Check

1. **VOCABULARY** Identify the transformation shown.

a. 

b. 

c. 

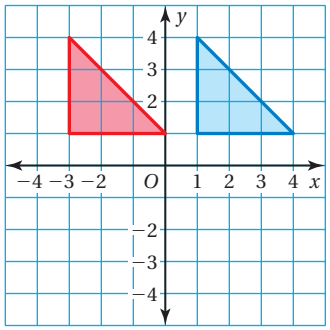
2. **VOCABULARY** What are the coordinates of the center of rotation in Example 2? Example 3?

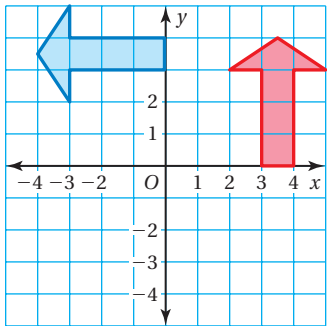
MENTAL MATH **A figure lies entirely in Quadrant II. In which quadrant will the figure lie after the given clockwise rotation about the origin?**

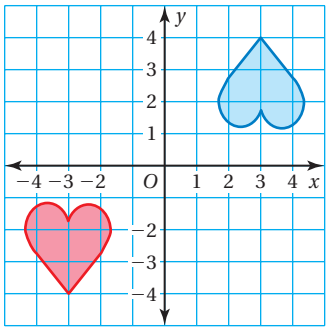
3. 90°
4. 180°
5. 270°
6. 360°

Practice and Problem Solving

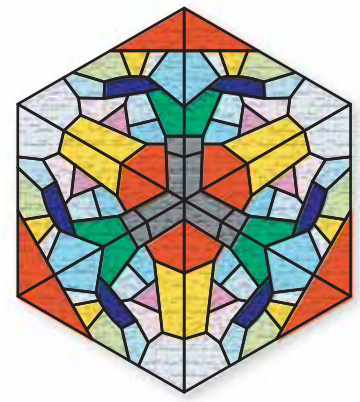
Tell whether the blue figure is a rotation of the red figure about the origin. If so, give the angle and direction of rotation.

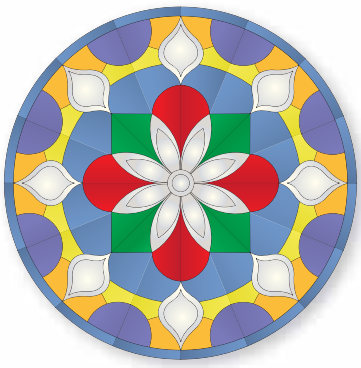
7. 

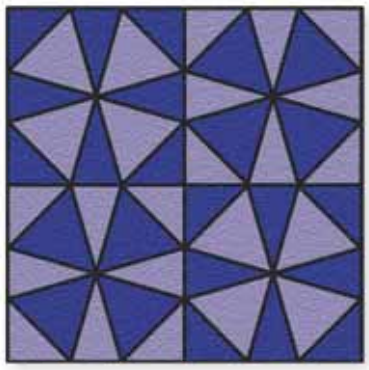
8. 

9. 

A figure has *rotational symmetry* if a rotation of 180° or less produces an image that fits exactly on the original figure. Explain why the figure has rotational symmetry.

10. 

11. 

12. 

English Spanish

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

2 3 **13.** 90° counterclockwise about the origin

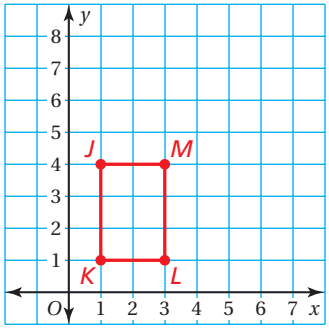
14. 270° clockwise about the origin

15. 180° clockwise about vertex D

16. 90° counterclockwise about vertex B

17. WRITING Why is it *not* necessary to use the words *clockwise* and *counterclockwise* when describing a rotation of 180°?

18. DILATIONS A *dilation* is a transformation in which a figure is enlarged or reduced.



a. Dilate Rectangle $JKLM$ by multiplying the x- and y-coordinates of each vertex by 2. Compare the original figure and its image.

b. Are the rectangles identical? Are they similar? Explain.

c. How do dilations differ from translations, reflections, and rotations?

19. TREASURE MAP You want to find the treasure located on the map at ✕. You are located at ●. The following transformations will lead you to the treasure, but they are not in the correct order. Find the correct order. Use each transformation exactly once.

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

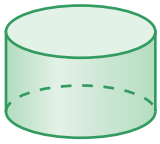
20. Reasoning A triangle is rotated 90° counterclockwise about the origin. Its image is translated 1 unit left and 2 units down. The vertices of the final triangle are $(-5, 0)$, $(-2, 2)$, and $(-2, -1)$. What are the vertices of the original triangle?

Fair Game Review What you learned in previous grades & lessons

Identify the solid. SKILLS REVIEW HANDBOOK

21.

22.



23. MULTIPLE CHOICE What is the value of $x - y$ when $x = -5$ and $y = -8$? *(Section 1.3)* SECTION 1.3

(A) -13 (B) -3 (C) 3 (D) 13