Name ____ Date __________

4.3 Rotations

For use with Exploration 4.3

Essential Question How can you rotate a figure in a coordinate plane?

1 EXPLORATION: Rotating a Triangle in a Coordinate Plane

Go to *BigIdeasMath.com* for an interactive tool to investigate this exploration.

Work with a partner.

a. Use dynamic geometry software to draw any triangle and label it $\triangle ABC$.

b. *Rotate* the triangle 90° counterclockwise about the origin to form $\triangle A'B'C'$.

c. What is the relationship between the coordinates of the vertices of $\triangle ABC$ and those of $\triangle A'B'C'$?

d. What do you observe about the side lengths and angle measures of the two triangles?

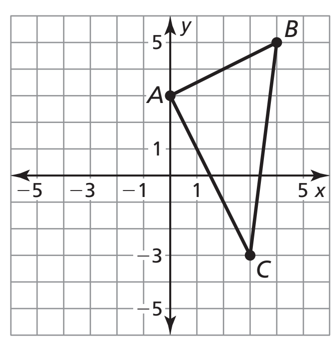
2 EXPLORATION: Rotating a Triangle in a Coordinate Plane

Go to *BigIdeasMath.com* for an interactive tool to investigate this exploration.

Work with a partner.

a. The point (x, y) is rotated 90° counterclockwise about the origin. Write a rule to determine the coordinates of the image of (x, y).

b. Use the rule you wrote in part (a) to rotate $\triangle ABC$ 90° counterclockwise about the origin. What are the coordinates of the vertices of the image, $\triangle A'B'C'$?



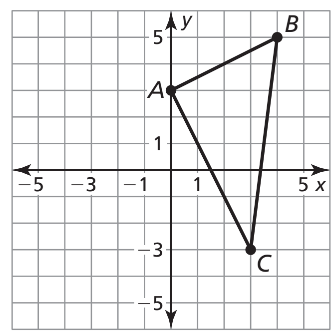
c. Draw $\triangle A'B'C'$. Are its side lengths the same as those of $\triangle ABC$? Justify your answer.

3 EXPLORATION: Rotating a Triangle in a Coordinate Plane

Work with a partner.

a. The point (x, y) is rotated 180° counterclockwise about the origin. Write a rule to determine the coordinates of the image of (x, y). Explain how you found the rule.

b. Use the rule you wrote in part (a) to rotate $\triangle ABC$ 180° counterclockwise about the origin. What are the coordinates of the vertices of the image, $\triangle A'B'C'$?



Communicate Your Answer

4. How can you rotate a figure in a coordinate plane?

5. In Exploration 3, rotate $\triangle A'B'C'$ 180° counterclockwise about the origin. What are the coordinates of the vertices of the image, $\triangle A''B''C''$? How are these coordinates related to the coordinates of the vertices of the original triangle, $\triangle ABC$?

Name ____ Date __________

4.3 Notetaking with Vocabulary
For use after Lesson 4.3

In your own words, write the meaning of each vocabulary term.

rotation

center of rotation

angle of rotation

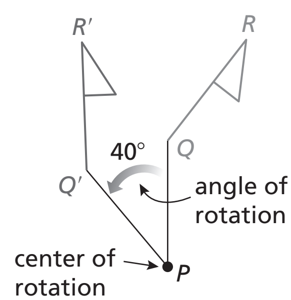
rotational symmetry

center of symmetry

Core Concepts

Rotations

A **rotation** is a transformation is which a figure is turned about a fixed point called the **center of rotation**. Rays drawn from the center of rotation to a point and its image form the **angle of rotation**.



A rotation about a point P through an angle of $x°$ maps every point Q in the plane to a point Q', so that one of the following properties is true.

- If Q is not the center of rotation P, then $QP = Q'P$ and $m\angle QPQ' = x°$, or
- If Q is the center of rotation P, then $Q = Q'$.

Notes:

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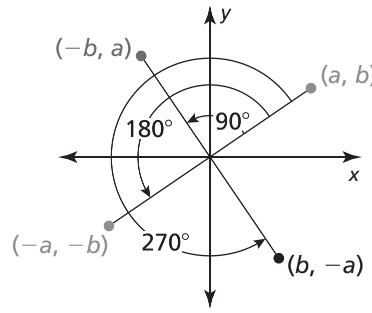
4.3 Notetaking with Vocabulary (continued)

Coordinate Rules for Rotations about the Origin

When a point (a, b) is rotated counterclockwise about the origin, the following are true.

- For a rotation of 90°, $(a, b) \rightarrow (-b, a)$.
- For a rotation of 180°, $(a, b) \rightarrow (-a, -b)$.
- For a rotation of 270°, $(a, b) \rightarrow (b, -a)$.



Notes:

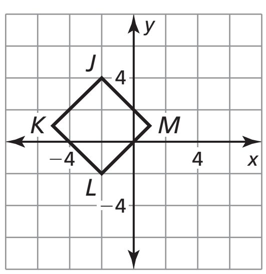
Postulate 4.3 Rotation Postulate

A rotation is a rigid motion.

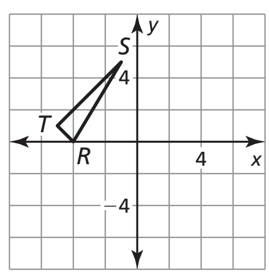
Extra Practice

In Exercises 1–3, graph the image of the polygon after a rotation of the given number of degrees about the origin.

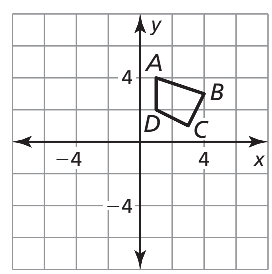
1. 180°



2. 90°



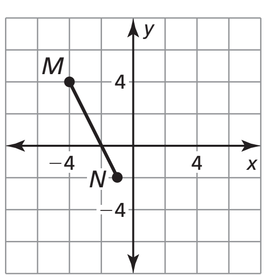
3. 270°



In Exercises 4–7, graph the image of $\overline{MN}$ after the composition.

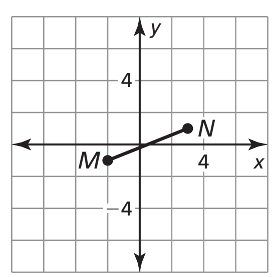
4. Reflection: x-axis

Rotation: 180° about the origin



5. Rotation: 90° about the origin

Translation: $(x, y) \rightarrow (x + 2, y - 3)$



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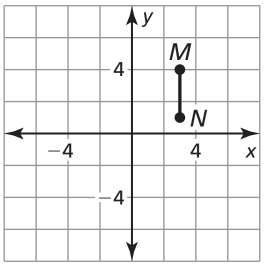
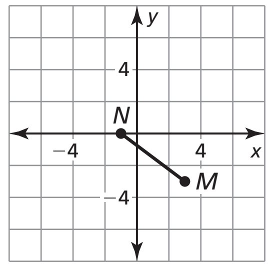
6. Rotation: 270° about the origin

Reflection: in the line $y = x$



7. Rotation: 90° about the origin

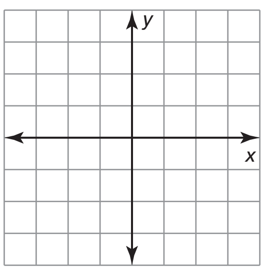
Translation: $(x, y) \rightarrow (x - 5, y)$



In Exercises 8 and 9, graph $\triangle JKL$ with vertices $J(2, 3)$, $K(1, -1)$, and $L(-1, 0)$ and its image after the composition.

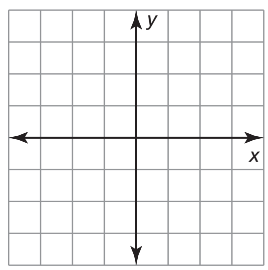
8. Rotation: 180° about the origin

Reflection: $x = 2$



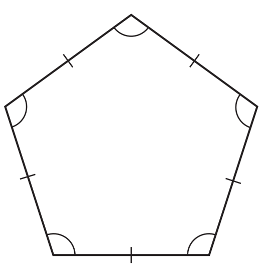
9. Translation: $(x, y) \rightarrow (x - 4, y - 4)$

Rotation: 270° about the origin



In Exercises 10 and 11, determine whether the figure has rotational symmetry. If so, describe any rotations that map the figure onto itself.

10.



11.