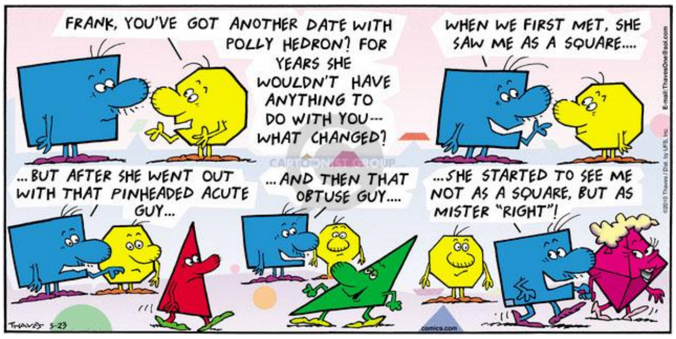
4.3: Rotations

Essential Question

How can you rotate a figure in a coordinate plane?

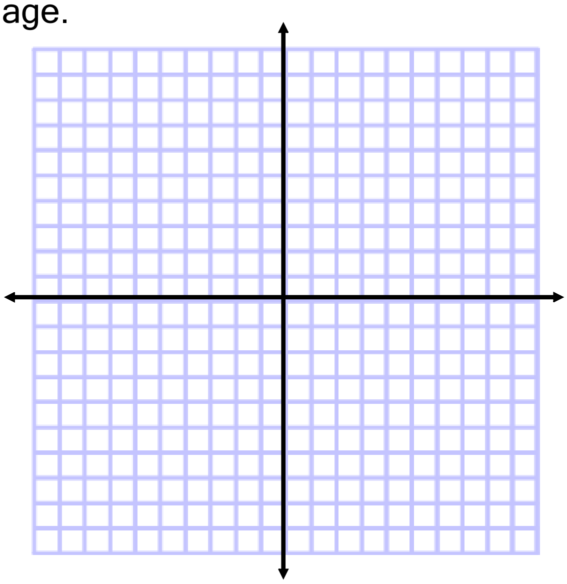


Graph the points below , then rotate the points counterclockwise about the origin by the given angle.
State the coordinates of the image.

1. A(2, 1); 90°

2. B(4, 1); 90°

3. C(2, 4); 90°



4. Now repeat the process for a rotation of 180° (all 3 points).

5. Now repeat the process for a rotation of 270°

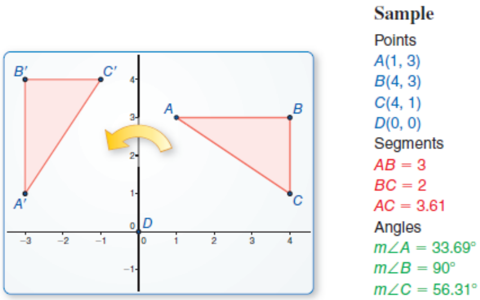
Work with a partner.

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 $\triangle A'B'C'$.

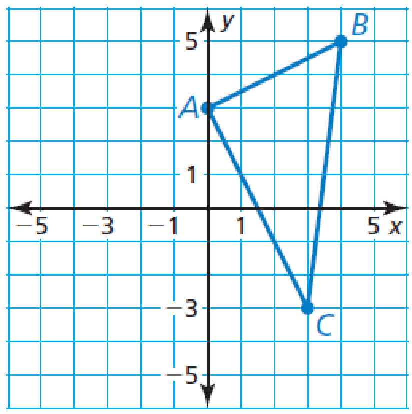
c. What is the relationship between the coordinates of the vertices of $\triangle ABC$ and those of $\triangle A'B'C'$?

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



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).

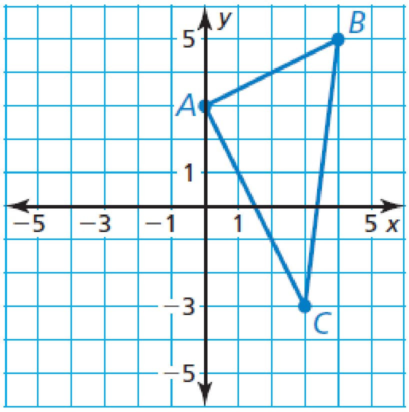


b. Use the rule you wrote in part (a) to rotate $\triangle ABC$ 90° counterclockwise about the origin. What are the coordinates of the vertices of the image, $\triangle A'B'C'$?

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

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 △*ABC* (from Exploration 2) 180° counterclockwise about the origin. What are the coordinates of the vertices of the image, △*A′B′C′*?

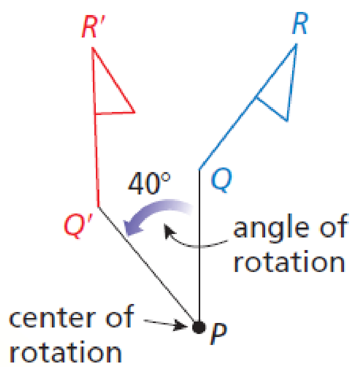
Core Concept

Rotations

A **rotation** is a transformation in 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 $Q = Q'$.

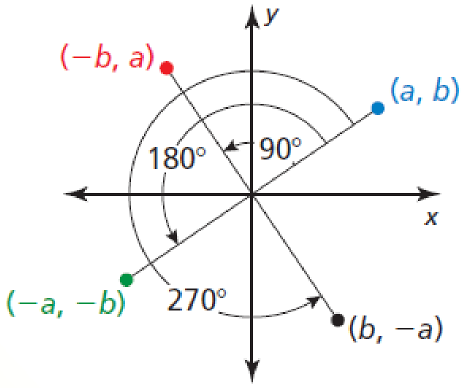


Core Concept

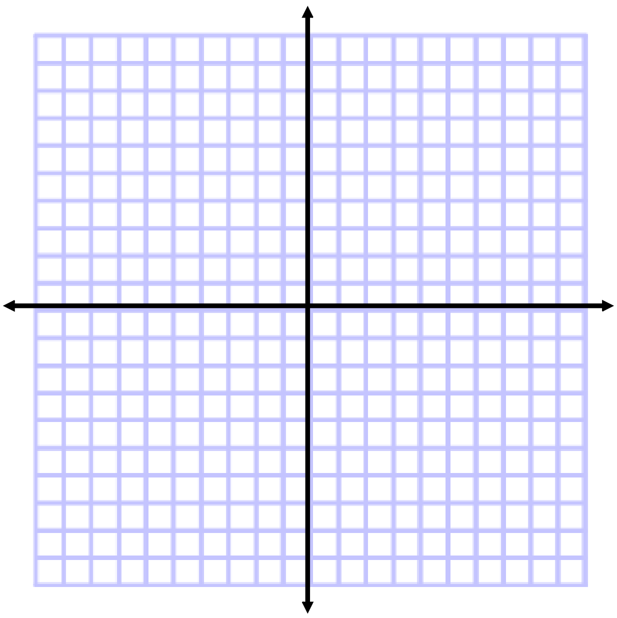
Coordinate Rules for Rotations about the Origin

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°, $(a, b) \rightarrow (b, -a)$.



Graph quadrilateral *RSTU* with vertices *R*(3, 1), *S*(5, 1), *T*(5, −3), and *U*(2, −1) and its image after a 270° rotation about the origin.



Postulate

Postulate 4.3 Rotation Postulate

A rotation is a rigid motion.

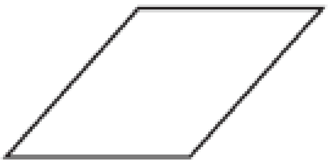
Graph $\overline{RS}$ with endpoints *R*(1, −3) and *S*(2, −6) and its image after the composition.

Reflection: in the *y*-axis

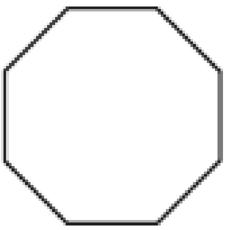
Rotation: 90° about the origin

Does the figure have rotational symmetry? If so, describe any rotations that map the figure onto itself.

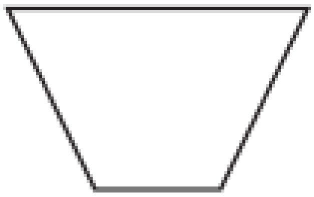
a. parallelogram



b. regular octagon

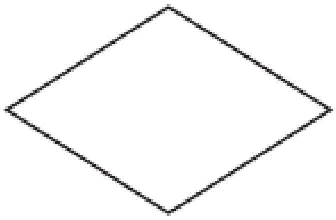


c. trapezoid

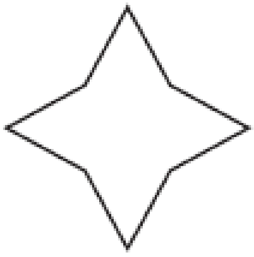


Determine whether the figure has rotational symmetry. If so, describe any rotations that map the figure onto itself.

rhombus



octagon



right triangle