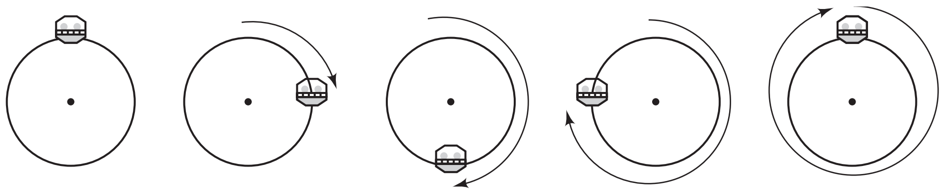
Topic 6: Rotations in the Coordinate Plane

for use after ***Shapes and Designs*** **Investigation 4**

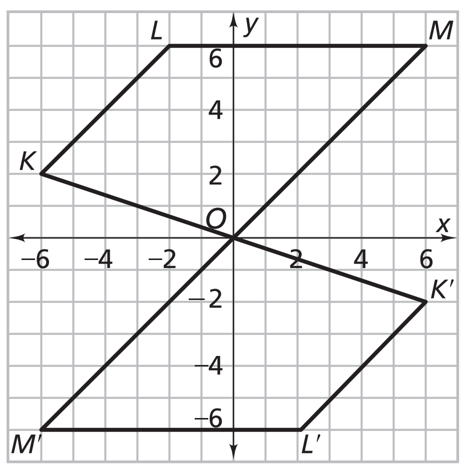
A **rotation** is a transformation that revolves a figure around a fixed point called the **center of rotation**. A rotation is **clockwise** if its direction is the same as that of a clock hand. A rotation in the other direction is called **counterclockwise**. A complete rotation is 360°.

A ferris wheel makes a 90° rotation with every $\frac{1}{4}$ turn.



Problem 6.1

The rotation of figure *KLMO* 180° about (0, 0), which is called the origin of the coordinate plane, is shown. In *K'L'MO*, point *K'* (kay-prime) is the rotation of point *K*, point *L'* is the rotation of point *L*, and point *M'* is the rotation of point *M*.



A. 1. Use a ruler to compare the lengths of *OM* and *OM'*.

2. What other pairs of segments can you find that have the same length?

3. When a point is rotated, how does its distance to the center of rotation change?

4. Describe the movement of the point at the center of rotation.

5. When you rotate a figure 180°, does it matter whether you rotate clockwise or counterclockwise? Explain.

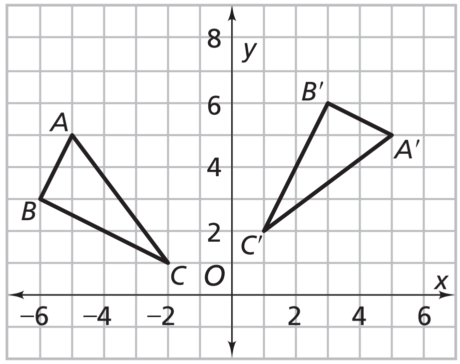
B. Describe how to rotate a polygon by using the locations of its vertices.

C. What is the new location of the point at (0, 6) after it has been rotated clockwise 180° about the origin?

D. If you think of (0, 6) and point *L* rotating together, how can that help you understand the position of *L'*?

Problem 6.2

The clockwise rotation of ΔABC 90°about the origin is shown at the right.



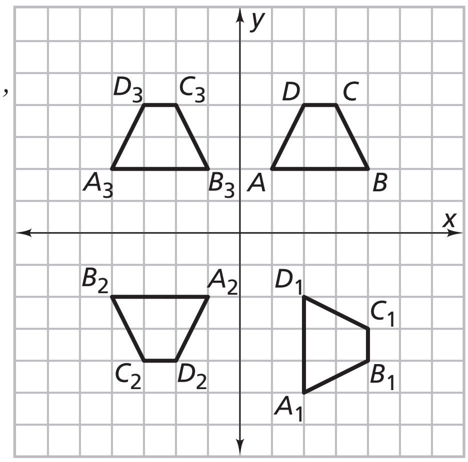
A. Compare the distances from the origin to points C and C'.

B. When a figure is rotated, does a vertex have to be the center of rotation?

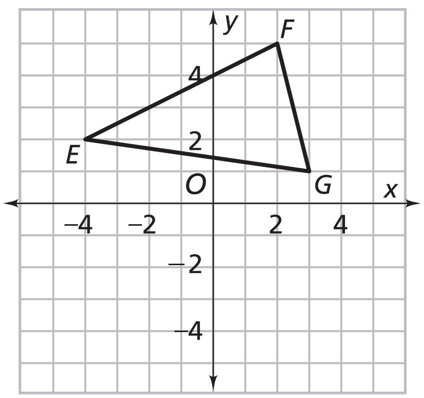
C. If you draw a line from A and a line from A' through the center of rotation, what is the measure of the angle formed at the intersection of the lines?

Exercises

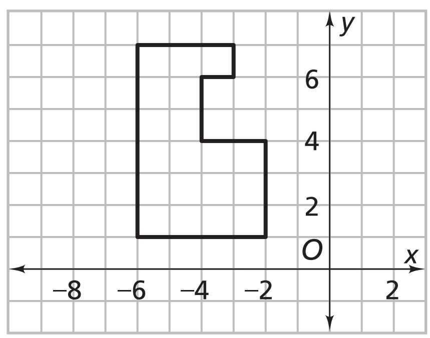
1. In the diagram, which figure is a rotation of figure $ABCD$? Explain how you know.



2. Copy ΔEFG onto graph paper and draw $\Delta E'F'G'$ as its image after a clockwise rotation of 180° about the origin.



3. Copy the figure at the right onto graph paper and draw its image after a counterclockwise rotation of 90° about the origin.



4. a. Explain how a 180° rotation of a shape tile can have the same visual results as a reflection.

b. How can you tell when a 180° rotation will have a different visual result?

At a Glance

Topic 6: Rotations in the Coordinate Plane

PACING 1 day

Mathematical Goals

- Identify rotations used to move a polygon from one location to another in the coordinate plane.
- Explain how rotations affect the location of a polygon in the coordinate plane.

Guided Instruction

Rotations can be more problematic for students than translations or reflections. Even the 180° rotation of a shape about the origin, as presented in Problem 6.1 can present difficulties as compared with a reflection of the same image across the *x*-axis. It may help students to concentrate on one vertex as a "leading point," visualize the arc made by that point, and then concentrate on the "trailing points" that follow the leader along the arcs of concentric circles.

No matter where the center of rotation is located—inside, outside or on the figure—the key indicator of a rotation is the distance from the center of rotation to any particular point on the figure. To confirm that a rotation has occurred, students can compare pre- and post-rotation distances of a given point with a compass, a ruler, or the marked edge of a piece of paper. They can also consider these two distances as diagonals of congruent rectangles formed on the coordinate grid. For instance, in Problem 6.2, a line segment from the origin to *C* or the origin to *C'* would both be the diagonal of a 2 unit × 1 unit rectangle and be of equal length.

Before Problem 6.1:

- *How many degrees of a counterclockwise rotation has the same effect as a 270° clockwise rotation?* (90°)
- *What part of the Ferris wheel at the top of the page does not change its location no matter what type of rotation takes place?* (the center)

After Problem 6.1:

- *How can you tell that K'L'M'O is not a reflection of KLMO across the x-axis?* (Corresponding points are not the same distance away from the x-axis on the opposite side.)
- *How would the graph look different if the 180° rotation had been counterclockwise instead of clockwise?* (There would be no difference.)

Before Problem 6.2:

- *Why do the two figures seem to be floating in space?* (The center of rotation is outside the figure.)
- *If you extend all three sides of both triangles, what type of angle do you think there would be where any the of the lines from corresponding sides intersect?* (90°)

You will find additional work on transformations in the grade 8 unit *Kaleidoscopes, Hubcaps, and Mirrors*.

Vocabulary

- rotation
- center of rotation
- clockwise
- counterclockwise

Materials

- Labsheets 6.1, 6.2, and 6ACE Exercises

ACE Assignment Guide for Topic 6

Core 1–5

Answers to Topic 6

Problem 6.1

A. **1.** The lengths are the same.

2. $KO = K'O$, $KL = K'L'$, $LM = L'M'$

3. The distance remains the same.

4. There is no change in the position of the center of rotation.

5. No, it does not matter. They result in the same transformation.

B. Rotate each of the vertices, then draw the sides.

C. $(0, -6)$

D. Answers may vary. Sample: Since L stays 2 units behind (0, 6) during the rotation, it ends up 2 units to the right of $(0, -6)$ after the rotation.

Problem 6.2

A. The distances are the same.

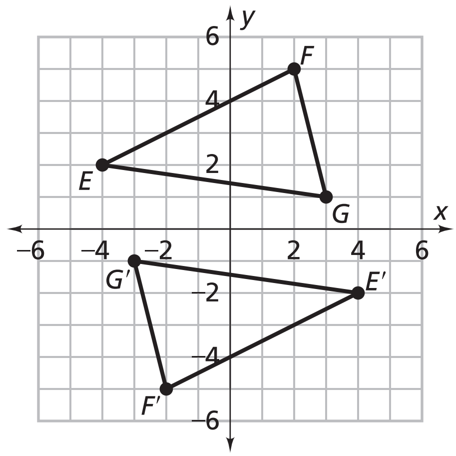
B. No

C. 90°

Exercises

1. Answers may vary. Sample: $A_2B_2C_2D_2$, because the distances from the origin to the pairs of corresponding vertices is the same.

2.



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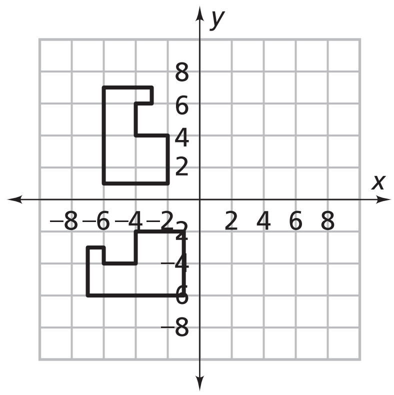


4. **a.** Answers may vary. Sample: The tile has to be symmetrical about a vertical axis.

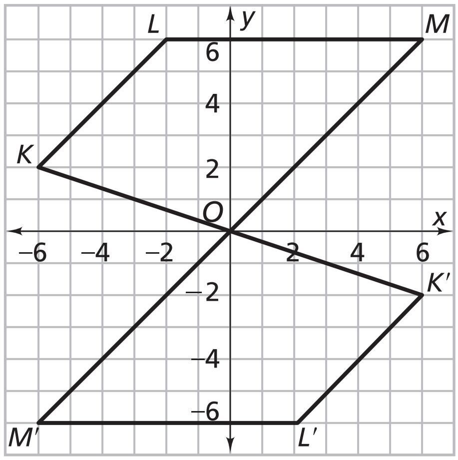
b. Answers may vary. Sample: The tile must not be symmetrical about a vertical axis.

Name ______________________ Date ____________ Class ____________

Labsheet 6.1

Topic 6

Rotations in the Coordinate Plane



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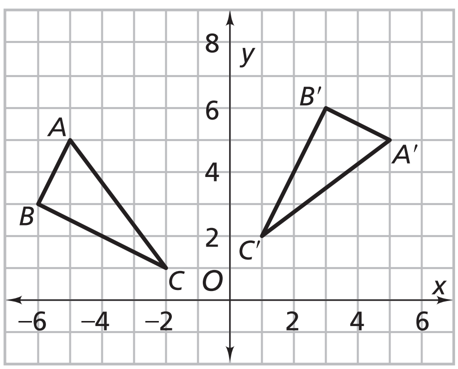
Labsheet 6.2

Topic 6

Rotations in the Coordinate Plane



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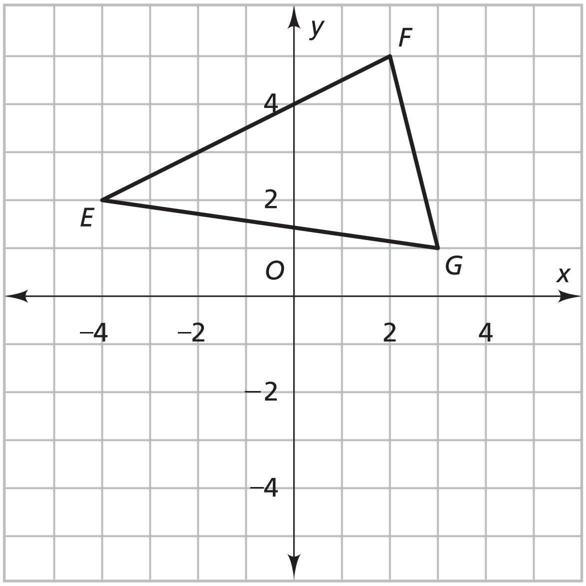
Labsheet 6ACE Exercises

Topic 6

2.



3.