# Chapter 7
Transformations

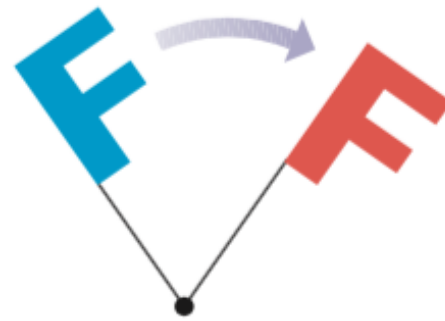# Section 1
Rigid Motion in a Plane

GOAL 1: Identifying Transformations

Figures in a plane can be reflected, rotated, or translated to produce new figures. The new figure is called the **image,** and the original figure is called the **preimage.** The operation that *maps*, or moves, the preimage onto the image is called a **transformation**.

In this chapter, you will learn about three basic transformations—*reflections, rotations*, and *translations*—and combinations of these. For each of the three transformations below, the blue figure is the preimage and the red figure is the image. This color convention will be used throughout this book.
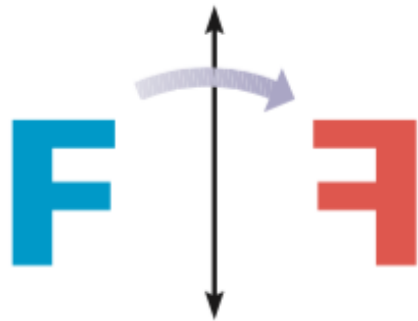
| Reflection in a line | Rotation about a point | Translation |

Some transformations involve labels. When you name an image, take the corresponding point of the preimage and add a prime symbol. For instance, if the preimage is A, then the image is A', read as "*A prime.*"

Example 1: Naming Transformations

Use the graph of the transformation at the right.

a) Name and describe the transformation.

    reflection; across the y-axis
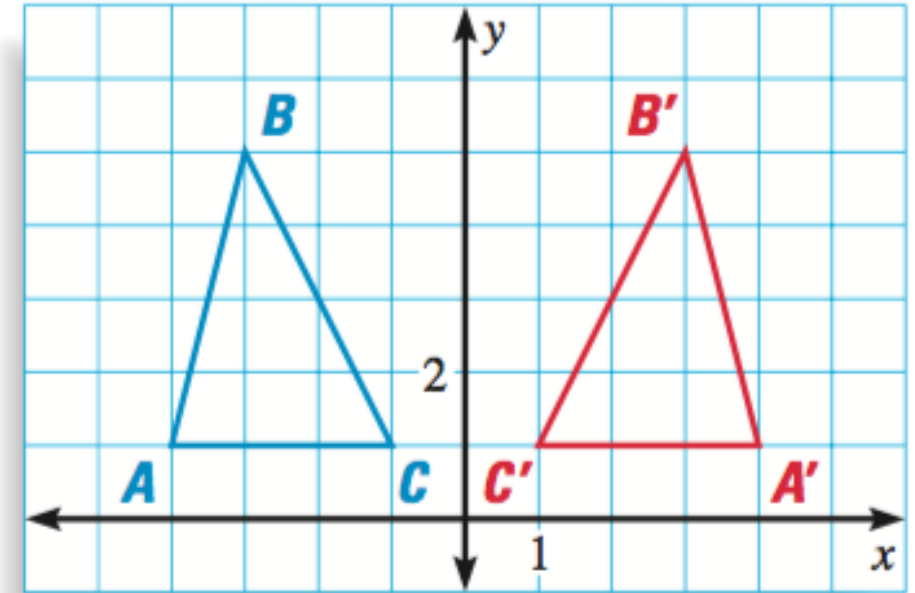
a) Name the coordinates of the vertices of the image.

Image: A'(4, 1)   B'(3, 5)   C'(1, 1)

Preimage: A(-4, 1)   B(-3, 5)   C(-1, 1)

a) Is ΔABC congruent to its image?

    Yes

An **isometry** is a transformation that preserves lengths. Isometries also preserve angle measures, parallel lines, and distances between points. Transformations that are isometries are called *rigid transformations*.
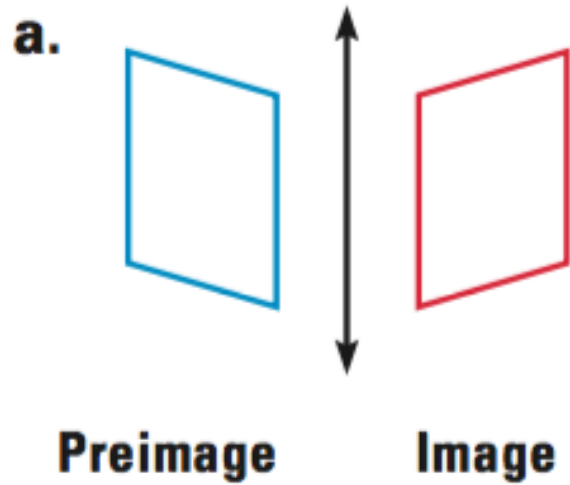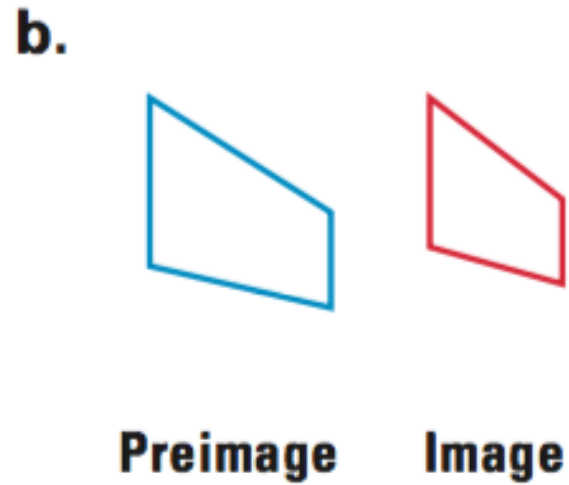
reflection

rotation

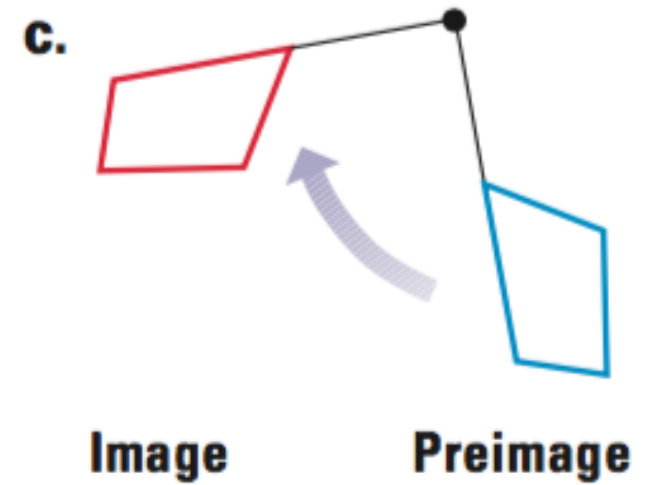translation

Example 2: Identifying Isometries

Which of the following transformations appear to be isometries?

a.

Preimage   Image

b.

Preimage   Image

c.

Image   Preimage

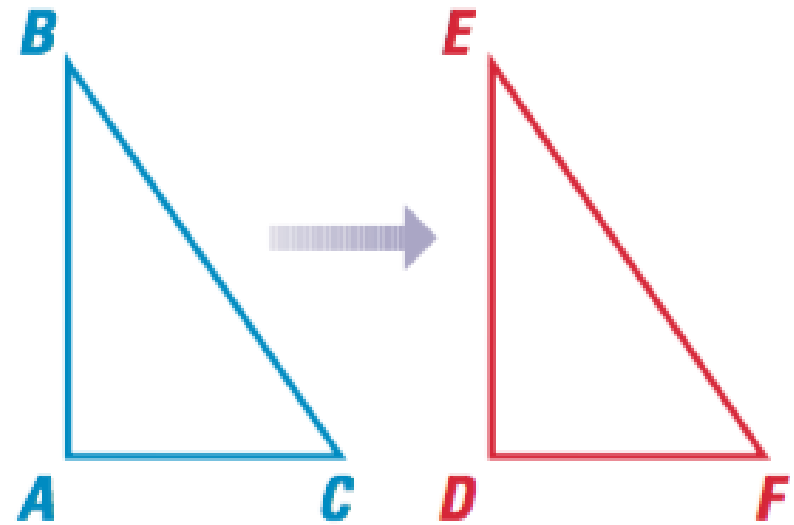Yes (reflection)   No (dilation)   Yes (rotation)

MAPPINGS You can describe the transformation in the diagram by writing "$\triangle ABC$ is *mapped onto* $\triangle DEF$." You can also use arrow notation as follows:
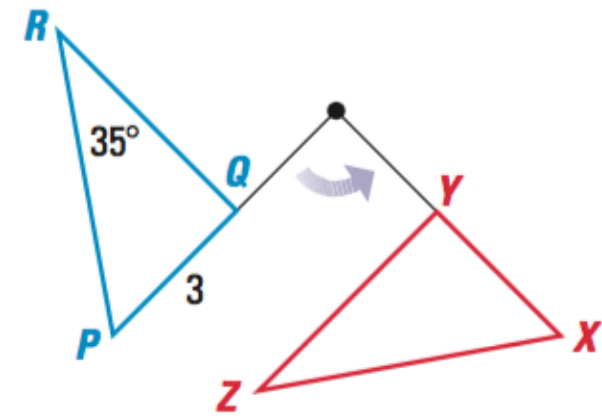
$$\triangle ABC \rightarrow \triangle DEF$$

The order in which the vertices are listed specifies the correspondence. Either of the descriptions implies that $A \rightarrow D$, $B \rightarrow E$, and $C \rightarrow F$.

Example 3: Preserving Length and Angle Measure

In the diagram, ΔPQR is mapped onto ΔXYZ. The mapping is a rotation. Given that ΔPQR → ΔXYZ is an isometry, find the length of XY and the measure of <Z.
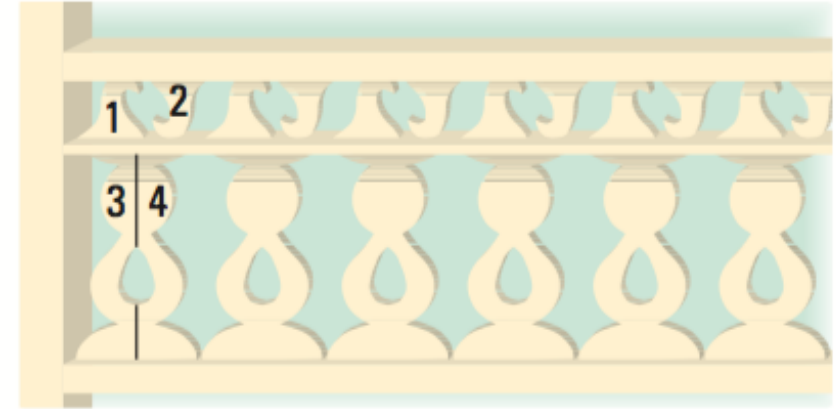
$$XY = 3$$

$$m\angle Z = 35°$$

GOAL 2: Using Transformations in Real Life

Example 4: Identifying Transformations

You are assembling pieces of wood to complete a railing for your porch. The finished railing should resemble the one below.


a) How are pieces 1 and 2 related? pieces 3 and 4?

1 to 2 → rotation 180*; 3 to 4 → reflection (vertical)

a) In order to assemble the rail as shown, explain why you need to know how the pieces are related.

It helps to continue the pattern of the railing.

Example 5: Using Transformations

Building a Kayak: Many building plans for kayaks show the layout and dimensions for only half of the kayak. A plan of the top view of a kayak is shown below.
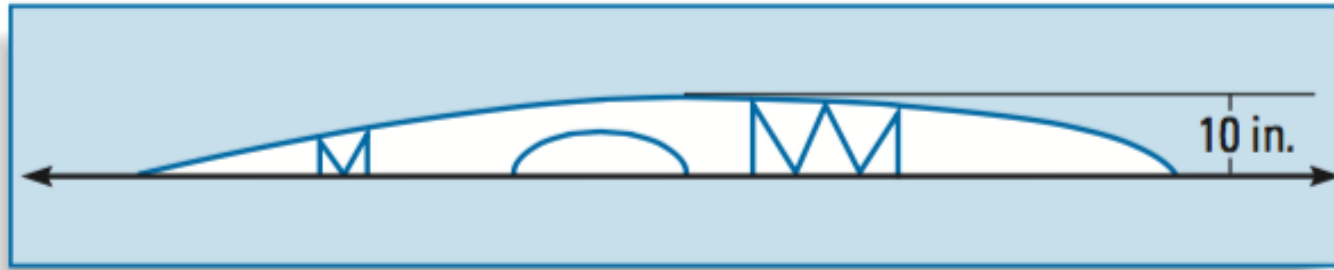
a) What type of transformation can a builder use to visualize plans for the entire body of the kayak?

reflection (horizontal)

a) Using the plan above, what is the maximum width of the entire kayak?

20 inches

EXIT SLIP