

Transformations

Translations and Reflections

A **transformation** changes a figure into another figure. The new figure is called the **image**.

A **translation** is a transformation in which a figure slides but does not turn. Every point of the figure moves the same distance and in the same direction. Translating a figure a units horizontally and b units vertically in a coordinate plane changes the coordinates of the figure as follows.

$$(x, y) \rightarrow (x + a, y + b)$$

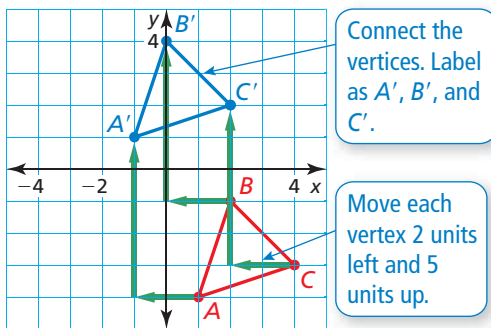
A **reflection** is a transformation in which a figure is reflected in a line called the **line of reflection**.

A reflection creates a mirror image of the original figure. Reflecting a figure in the x -axis or the y -axis changes the coordinates of the figure as follows.

$$\text{x-axis: } (x, y) \rightarrow (x, -y) \quad \text{y-axis: } (x, y) \rightarrow (-x, y)$$

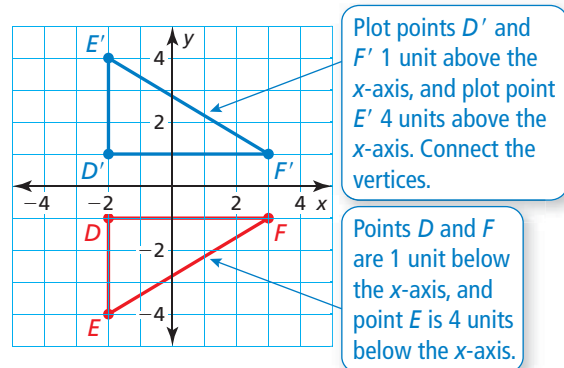
In a translation or reflection, the original figure and its image are congruent.

Example 1 Translate the red triangle 2 units left and 5 units up. What are the coordinates of the image?



► The coordinates of the image are $A'(-1, 4)$, $B'(0, 7)$, and $C'(1, 6)$.

Example 2 Reflect the red triangle in the x -axis. What are the coordinates of the image?



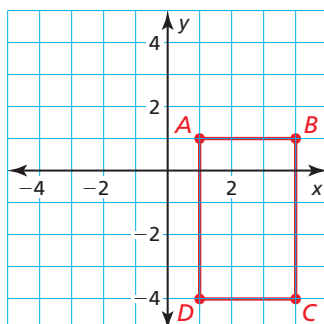
► The coordinates of the image are $D'(1, 1)$, $E'(2, 4)$, and $F'(3, 1)$.

Practice

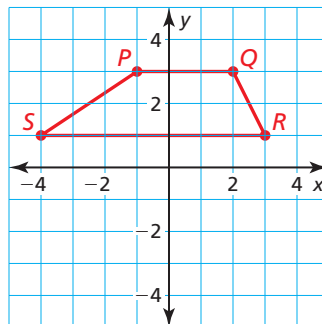
Check your answers at BigIdeasMath.com.

Find the coordinates of the figure after the transformation.

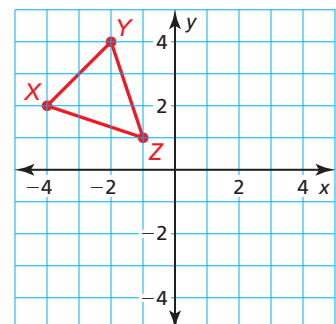
1. Translate the rectangle 2 units left and 3 units up.



2. Reflect the trapezoid in the x -axis.



3. Reflect the triangle in the y -axis.



Transformations

Rotations and Dilations

A **rotation** 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**.

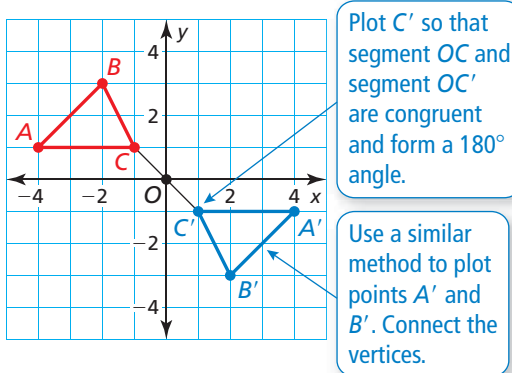
A **dilation** is a transformation in which a figure is made larger or smaller with respect to a point called the **center of dilation**.

In a rotation, the original figure and its image are congruent. In a dilation, the original figure and its image are similar. The ratio of the side lengths of the image to the corresponding side lengths of the original figure is the **scale factor** of the dilation.

Dilating a figure in a coordinate plane with respect to the origin by a scale factor k changes the coordinates of the figure as follows.

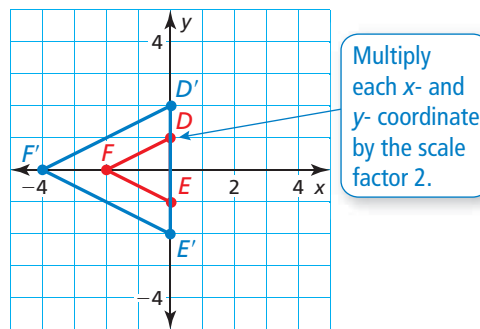
$$(x, y) \rightarrow (kx, ky)$$

Example 1 Rotate the red triangle 180° about the origin.



► The coordinates of the image are $A'(4, -1)$, $B'(2, -3)$, and $C'(1, -1)$.

Example 2 Dilate the red triangle with respect to the origin using a scale factor of 2.



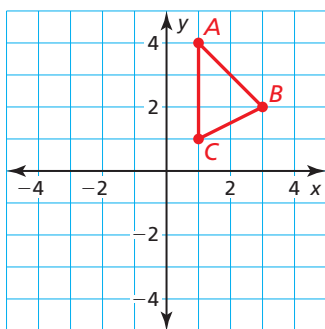
► The coordinates of the image are $D'(0, 2)$, $E'(0, -2)$, and $F'(-4, 0)$.

Practice

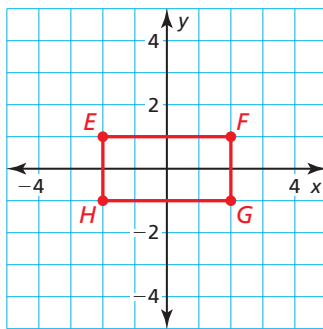
Check your answers at BigIdeasMath.com.

Find the coordinates of the figure after the transformation.

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



2. Dilate the rectangle with respect to the origin using a scale factor of 3.



3. Dilate the trapezoid with respect to the origin using a scale factor of $\frac{1}{2}$.

