Name _____ Date _____

LESSON 9.4

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Study Guide

For use with pages 598–605

GOAL **Rotate figures about a point.**

Vocabulary

A **rotation** is a transformation in which a figure is turned about a fixed point.

The **center of rotation** is the fixed point in which a figure is turned about.

The **angle of rotation** is formed from rays drawn from the center of rotation to a point and its image.

Theorem 9.3 Rotation Theorem: A rotation is an isometry.

EXAMPLE 1 Rotate a figure using the coordinate rules

Graph quadrilateral *RSTU* with vertices *R*(1, −1), *S*(3, −1), *T*(3, −5), and *U*(0, −4). Then rotate the quadrilateral 270° about the origin.

Solution

$(a, b) \rightarrow (b, -a)$

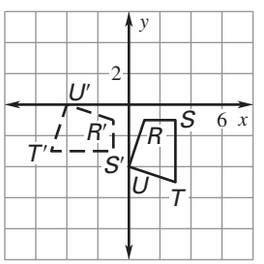
$R(1, -1) \rightarrow R'(-1, -1)$

$S(3, -1) \rightarrow S'(-1, -3)$

$T(3, -5) \rightarrow T'(-5, -3)$

$U(0, -4) \rightarrow U'(-4, 0)$

Graph the image $R'S'T'U'$.



Exercise for Example 1

1. Graph $\triangle JKL$ with vertices $J(4, 1)$, $K(5, 4)$, and $L(7, 0)$. Rotate the triangle 90° about the origin.

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EXAMPLE 2 Use matrices to rotate a figure

Trapezoid *EFGH* has vertices *E*(−4, 1), *F*(−4, 3), *G*(0, 3), and *H*(1, 1). Find the image matrix for a 180° rotation of *EFGH* about the origin. Graph *EFGH* and its image.

Solution

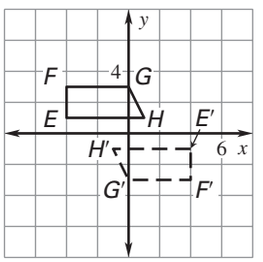
STEP 1 **Write** the polygon matrix: $\begin{matrix} E & F & G & H \end{matrix}$

$$\begin{bmatrix} -4 & -4 & 0 & 1 \\ 1 & 3 & 3 & 1 \end{bmatrix}$$

STEP 2 **Multiply** by the matrix for a 180° rotation.

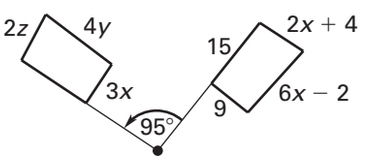
$$\begin{bmatrix} -1 & 0 \\ 0 & -1 \end{bmatrix} \begin{matrix} E & F & G & H \end{matrix} \begin{bmatrix} -4 & -4 & 0 & 1 \\ 1 & 3 & 3 & 1 \end{bmatrix} = \begin{matrix} E' & F' & G' & H' \end{matrix} \begin{bmatrix} 4 & 4 & 0 & -1 \\ -1 & -3 & -3 & -1 \end{bmatrix}$$

STEP 3 **Graph** the preimage *EFGH* and the image *E′F′G′H′*.



EXAMPLE 3 Use Theorem 9.3

Find the value of *y* in the rotation of the quadrilateral.



Solution

By Theorem 9.3, the rotation is an isometry, so corresponding side lengths are equal. Then $3x = 9$, so $x = 3$. Now set up an equation to solve for y.

$4y = 6x - 2$	Corresponding lengths in an isometry are equal.
$4y = 6(3) - 2$	Substitute 3 for x.
$y = 4$	Solve for y.

Exercises for Examples 2 and 3

Use the trapezoid *EFGH* in Example 2. Find the image matrix after the rotation about the origin. Graph the image.

2. 90° **3.** 270° **4.** 360°

5. In Example 3, find the value of z in the rotation of the quadrilateral.

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