4.3 - Rotations

Lesson Objectives

- Perform rotations
- Perform compositions with rotations
- Identify rotational symmetry

Sep 29-9:06 AM

4 Types of Transformations

1.) Translation (Translate)
 – Move or slide

2.) Reflection (Reflect)
 – Mirror image over a line

3.) Rotation (Rotate)
 – Turn or spin around a point

4.) Dilation (Dilate)
 – Increase or decrease scale/size

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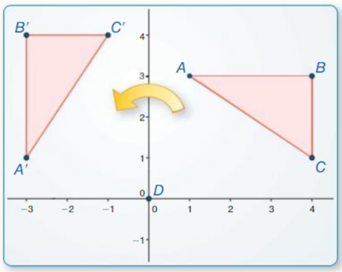
Essential Question How can you rotate a figure in a coordinate plane?



EXPLORATION 1 **Rotating Triangle in the Coordinate Plane**

Work with your group.

a.) The figure at the right shows $\triangle ABC$ rotated 90° counterclockwise around the origin to form $\triangle A'B'C'$. List the coordinates of both triangles below.

$A(\; , \;)$ $A'(\; , \;)$
$B(\; , \;)$ $B'(\; , \;)$
$C(\; , \;)$ $C'(\; , \;)$

b.) Using the coordinates from part (a), write a rule to describe the rotation.

$(x,y) \rightarrow (-y, x)$

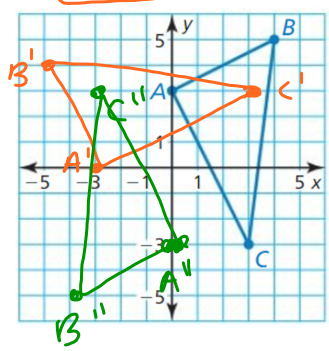
Sep 29-9:06 AM

EXPLORATION 2 **Rotating Triangle in the Coordinate Plane**

Work with your group.

a.) Using your rule from Exploration 1 part (b), write the coordinates when $\triangle ABC$ below is rotated 90° counterclockwise around the origin to form $\triangle A'B'C'$.

$A(0, 3)$ $A'(-3, 0)$
$B(4, 5)$ $B'(-5, 4)$
$C(3, -3)$ $C'(3, 3)$



b.) Using the coordinates of from part (a), rotate $\triangle ABC$ 90° counterclockwise again to form $\triangle A''B''C''$. Write the new coordinates below.

180

$A''(0, -3)$
$B''(-4, -5)$
$C''(-3, 3)$

c.) Performing two rotations of 90° is the same as performing one rotation of 180°. Using the coordinates from parts (a) and (b), write a rule to describe a rotation of 180°.

$(x,y) \rightarrow (-x, -y)$

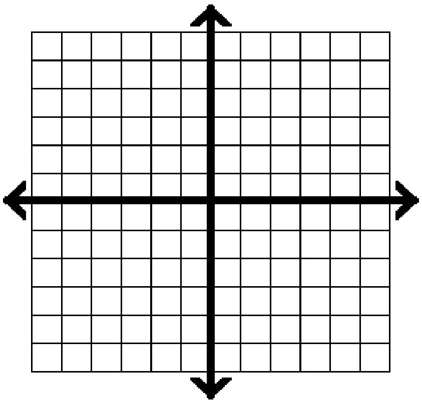
270° $(x, y) \rightarrow (y, -x)$

Sep 29-9:06 AM

Mental Floss: Tuesday, Nov 16th

Given the triangle below, perform the following composition of transformations (in order). List the coordinates after each transformation.

$H(-2,3)$ and $I(3,0)$



Translation: $(x,y) \rightarrow (x+2,y)$

Reflection: $y=-x$

$H'(\ ,\ )$ $H''(\ ,\ )$

$I'(\ ,\ )$ $I''(\ ,\ )$

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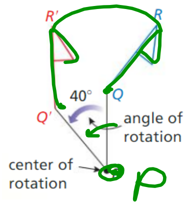
Rotation = Turns a figure around a fixed point → A point that does not move

Every to rotation has 3 key pieces of information.

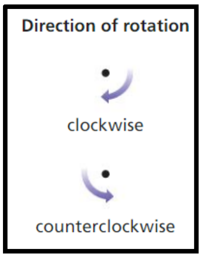


1.) Center of rotation = the fixed point you are rotating around

2.) Angle of rotation = how far (in degrees) you are rotating

3.) Direction = which way to turn

(clockwise or counterclockwise) →



CW

CCW

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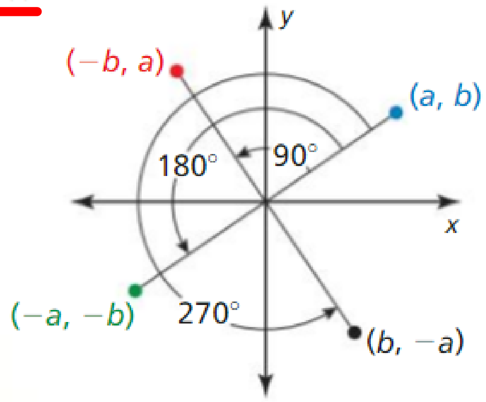
Coordinate Rules for Rotations about the Origin

When a point (a, b) is rotated counterclockwise about the origin, the following are true.

- For a rotation of 90°, $(a, b) \rightarrow (-b, a)$. | Same as 270° CW
- For a rotation of 180°, $(a, b) \rightarrow (-a, -b)$. | Same as 180° CW
- For a rotation of 270°, $(a, b) \rightarrow (b, -a)$. | Same as 90° CW



Key Points:

- If no direction is listed (CW or CCW), then:
  - Positive angles of rotation are always CCW
  - Negative angles of rotation are always CW

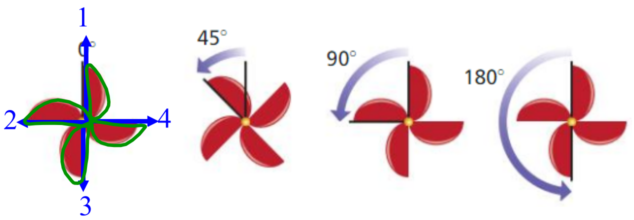
Sep 29-9:06 AM

Rotational Symmetry Website: https://www.geogebra.org/m/z9tM2QKu

A figure has *rotational symmetry* if it can be rotated 180° or less around a central point in such a way that the figure and its rotated image look exactly the same.

To determine the possible angles of rotation, identify how many identical "spokes" the figure has, and divide 360° by this number. This will give you the smallest angle of rotation.

$$\frac{360°}{4} = 90°$$

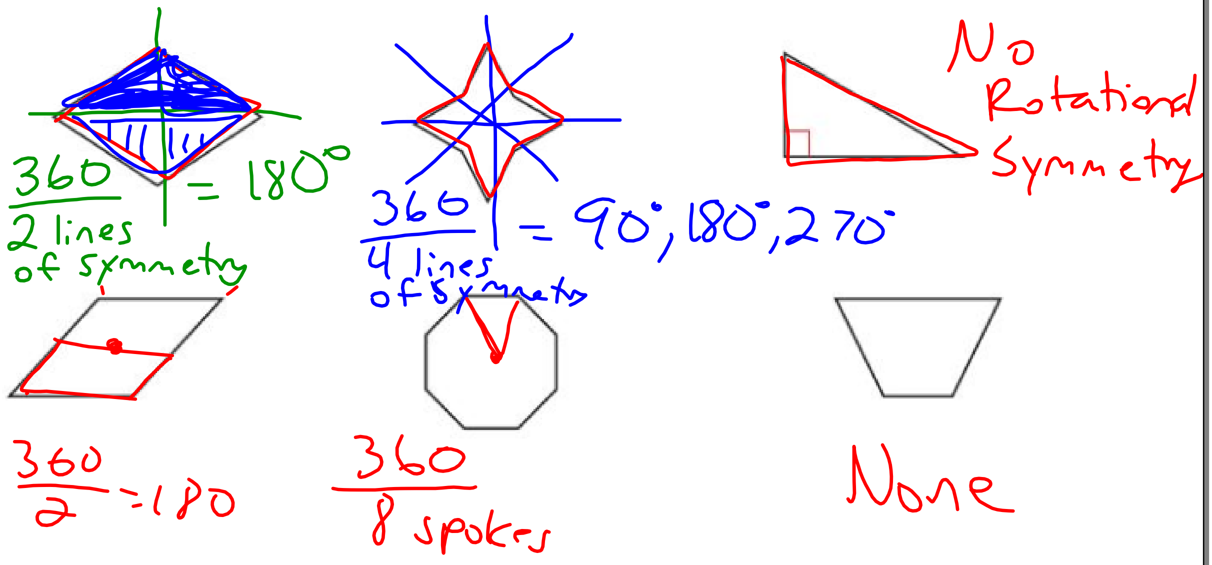


90°, 180°, 270°

Sep 29-9:06 AM

EXAMPLE 4 Identifying Rotational Symmetry

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

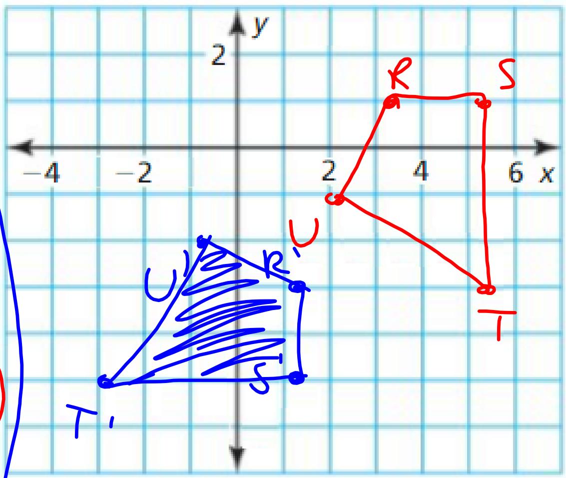


EXAMPLE 2 Rotating a Figure in the Coordinate Plane

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.

$(x, y) \rightarrow (y, -x)$

$R(3,1) \rightarrow R'(1,-3)$
$S(5,1) \rightarrow S'(1,-5)$
$T(5,-3) \rightarrow T'(-3,-5)$
$U(2,-1) \rightarrow U'(-1,-2)$



Homework

4.3 p.194

- #**11,13,16-19,** 8,23,24,39 (Assigned Tues Nov. 16)

HW Check over all on Thursday Nov. 18

Sep 29-9:06 AM