

# VISUALIZING ROTATIONS

## Ready (Summary)

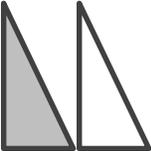
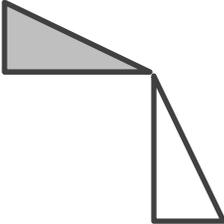
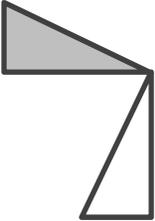
We will experiment with rotations, and learn some properties of this isometry. We will use rotations to create a design. We will explore how translations and rotations can be obtained from a composition of reflections.

## Set (Goals)

- Distinguish between a translation, reflection, and rotation
- Visualize, and then perform rotations using patty paper
- Apply properties of rotations to create a design.
- Explore how translations and rotations can be obtained from the composition of reflections.

## Go (Warmup)

For each transformation, describe steps that map the figure (shaded) to its image (unshaded). Use patty paper if needed. Color the original figure blue and the image red if desired.

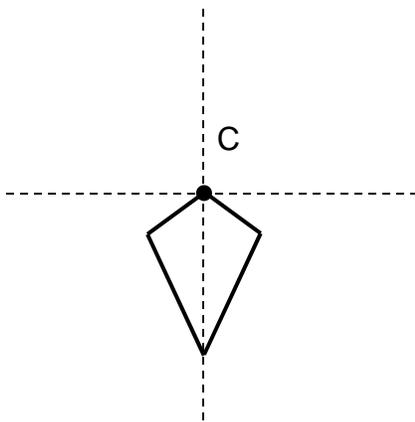
		Transformation S	Transformation F	Transformation T
1.	Label the vertices of the original figure $POT$ and its image $P'O'T'$			
2.	Describe steps that map the figure to its image.			
3.	Do these figures appear congruent?			
4.	Do these transformations have the same orientation?			
5.	Identify the transformation.			

# ROTATIONS

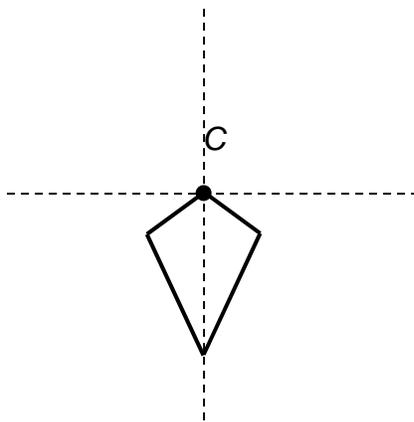
A rotation about a point  $P$  through angle  $\alpha$  is a transformation such that: (1) if point  $A$  is different from  $P$ , then  $PA = PA'$  and the measure of  $\angle APA' = \alpha$ ; and (2) if point  $A$  is the same as  $P$ , then  $A' = A$ .

- Draw this shape on patty paper with pencil markings on both sides of the paper.
- For each figure and point of rotation  $C$ , visualize where the image will be.
- Perform the transformation using patty paper and record.
- Shade the original figure blue and its image red.

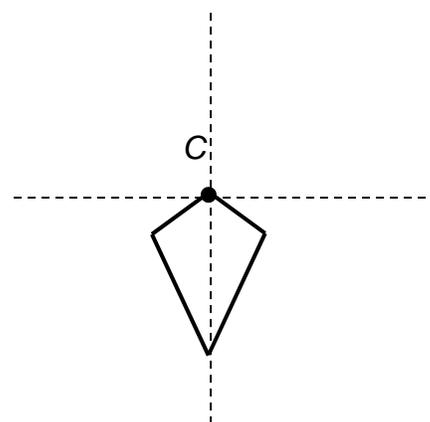
1a. Rotate  $90^\circ$ .



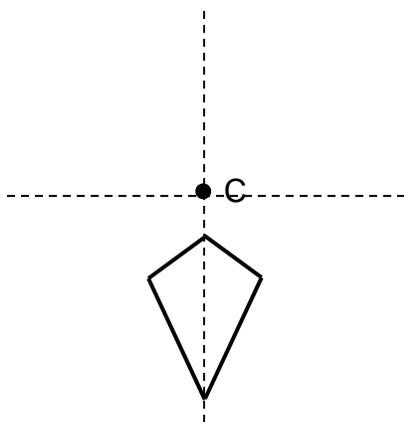
1b. Rotate  $180^\circ$ .



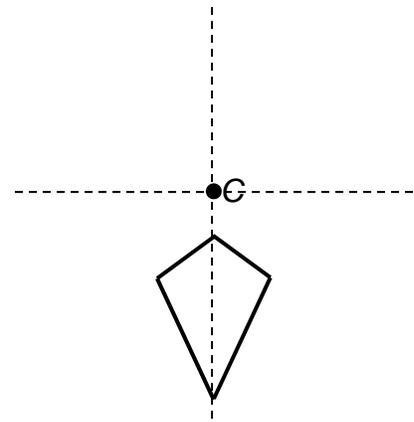
1c. Rotate  $270^\circ$ .



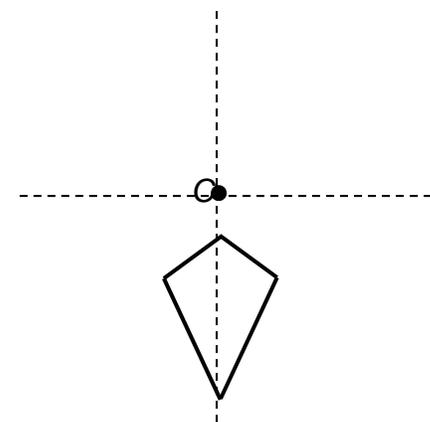
2a. Rotate  $90^\circ$ .



2b. Rotate  $180^\circ$ .



2c. Rotate  $270^\circ$ .

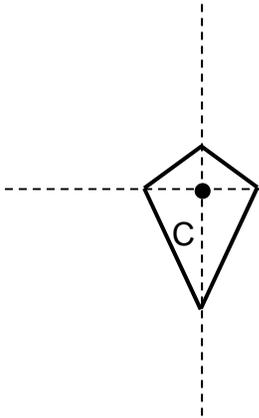


3. Make a conjecture about the relationship between the distance from the center  $C$  of the rotation to corresponding points on the figure and its image.

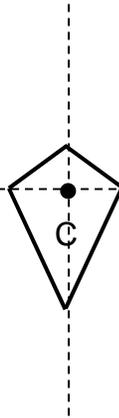
## ROTATIONS (continued)

- Draw this shape on patty paper with pencil markings on both sides of the paper.
- Shade each figure blue.
- For each figure and point of rotation  $C$ , visualize where the image will be.
- Perform the transformation using patty paper and record.
- Shade the original figure blue and its image red.

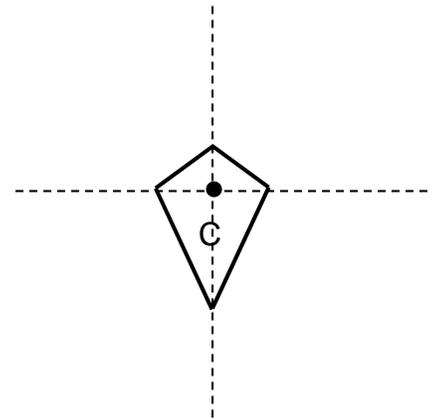
4a. Rotate  $90^\circ$ .



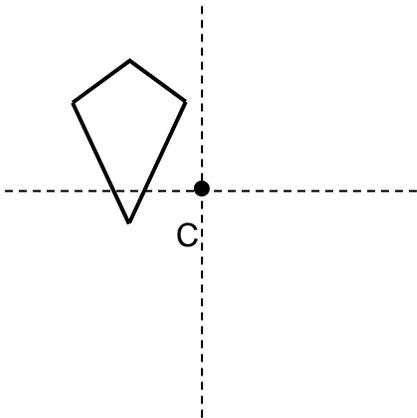
4b. Rotate  $180^\circ$ .



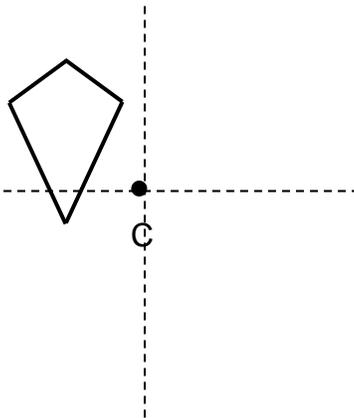
4c. Rotate  $270^\circ$ .



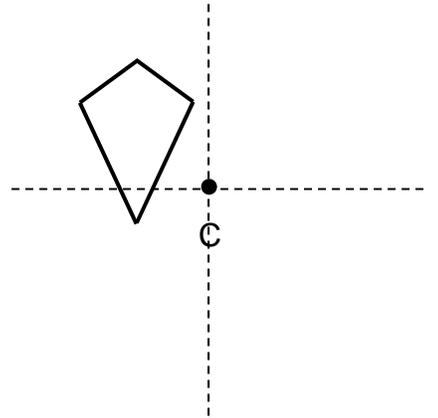
5a. Rotate  $90^\circ$ .



5b. Rotate  $180^\circ$ .



5c. Rotate  $270^\circ$ .

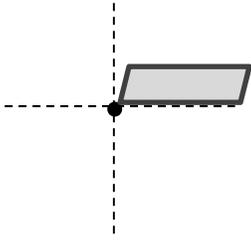
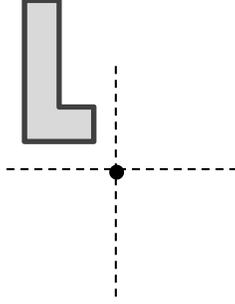
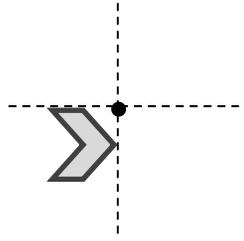


6. Suppose the letter "Q" were placed somewhere on this paper. What would the image of Q be under the rotation for 5B?
  
7. Does your conjecture about distances from problem 3 on the previous page hold for these examples? Revise your conjecture as needed.

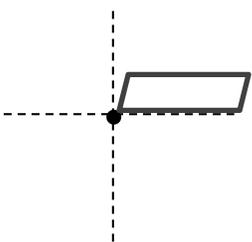
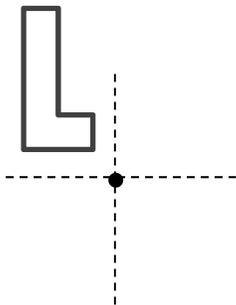
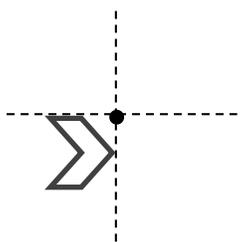
# PRACTICE WITH ROTATIONS

Use patty paper. Remember we measure angles from any point in the figure to its image in a counter clockwise direction.

Figures are given here. Shade each figure blue. For each figure, point of rotation, and angle of rotation draw the image. Shade it red. Label at two least corresponding points.

<p>1. Rotate <math>90^\circ</math></p> 	<p>2. Rotate <math>180^\circ</math></p> 	<p>3. Rotate <math>270^\circ</math></p> 
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The images of figures are given here. Shade each image red. For each image, point of rotation, and angle of rotation, draw the original figure. Label at least two corresponding points.

<p>4. Rotate <math>90^\circ</math></p> 	<p>5. Rotate <math>180^\circ</math></p> 	<p>6. Rotate <math>270^\circ</math></p> 
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7. What happens to the center under a rotation?
8. What happens to every other point in the plane under a rotation?
9. Use the examples above to explain what it means for a rotation to preserve:

Distance

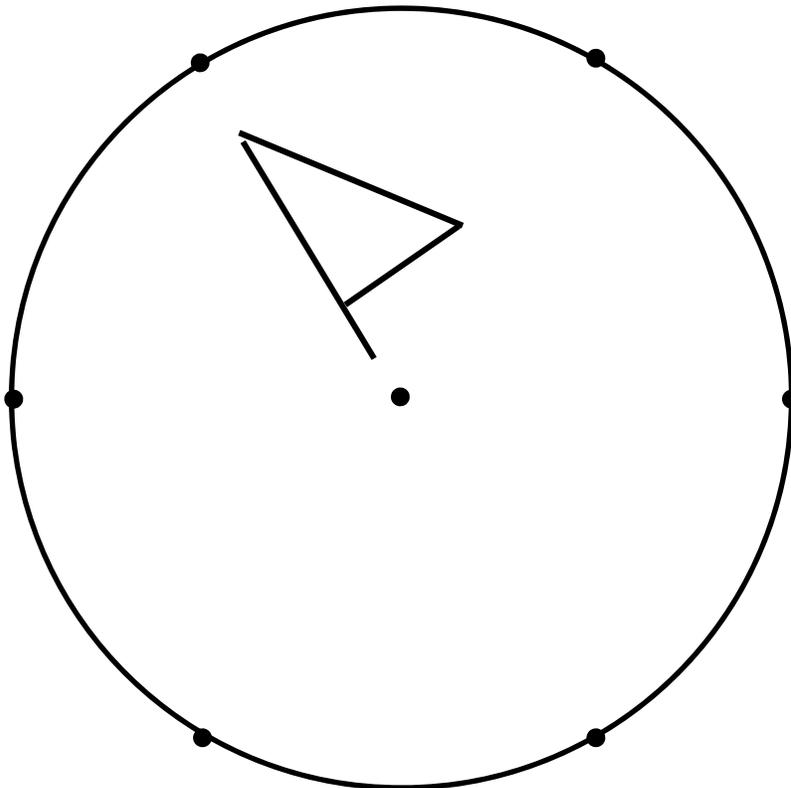
Parallelism

Angle measure

Size and shape

# ROTATION DESIGN PROJECT

1. Here is a technique for making a design where the angle of rotation is  $60^\circ$ .
  - Place a sheet of patty paper over the circle below. Mark the six points on the circle, the center of the circle, and the figure.
  - Put the point of your pencil on the center of the circle and rotate until the 6 points align. Trace the triangle flag in its new location.
  - Repeat step 2 until there are six congruent figures on your patty paper.
2. Label the center point of rotation  $P$ .
3. Explain why the angle of rotation is  $60^\circ$ . \_\_\_\_\_



Create your own design using the technique above. You may begin with any number of equally spaced points on the circle and rotate any shape(s) you like. Identify the center of the rotation and angle of rotation. Color your design.

## EXPLORING DEFINITIONS

One way to define translations and reflections is as a composition of reflections.

- A translation is the composition of two reflections over parallel lines.
  - A rotation is the composition of two reflections over intersecting lines.
1. Create a diagram that shows an image under translation. See if you can find parallel lines such that the composition of reflection over the lines will result in the image. Try it with other translations. Explain a general strategy for the parallel lines that lead to a composition of reflections that map the original figure to its image.
  2. Create a diagram that shows an image under rotation. See if you can find intersecting lines such that the composition of reflection over the lines will result in the image. Explain a general strategy for the intersecting lines that lead to a composition of reflections that map the original figure to its image.