MS 319

8th Grade

NYC Saturday Tutoring Program

Mathematics Department

Name: ______________________________ Class: ___________________

Lesson 3: Translation --Rotation

OBJECTIVES: SWBA to

Describe the effect of a rotation on two-dimensional figures using coordinates. **(8. G.3)**

INTRODUCTION

For the past two meetings we have being talking about how geometric transformations are integral parts of our daily lives. Two meetings ago, we talked about reflection, and during our last meeting, we talk about translations. Today, we will discuss rotations, which are probably the most abstract of the four transformations: reflection, translation, rotation, and dilation. The word “rotation” means “spin” or turning around a center. It is important to realize that when we rotate an object or figure around a given point or center, the image of the object is congruent to the original object. That is, a rotation is isometric—it keeps the same shape (sides and angles) and size as the original object (pre-image). When do we use rotation in our daily lives? At all times! Just think of turning around! We use rotation when using the joy stick in the PlayStation controller, when getting on ferry wheel. And, as we mention before, architects, engineers, and computer programmers and games developers use computer imaging create animations, video games, simulations using the geometrical transformations.

MINI-LESSON/Vocabulary (I DO):

As we mentioned before, a rotation is the spinning or circular motion of a geometric figure about a certain point. The amount of rotation is described in terms of degrees. If the degrees are positive, the rotation is performed counterclockwise; if they are negative, the rotation is clockwise. The figure will not change size or shape. The initial figure is always called the **pre-image** while the rotated figure will be called the **image**. Unless, I physically rotate the object, which is not always possible, there are certain notations that we need to use to perform a rotation. The mathematical notation for rotation is usually written as follows:

R (center, rotation) where the center is the point of rotation and the rotation is given in degrees. Often, rotations are written using **coordinate notation**, which means that their coordinates on the coordinate-plane are given. There are some general rules for either clockwise (negative degree rotation) or counter **clock rotation** (positive degree rotation) of objects using the most common degree measures (90°, 180°, and 270°).

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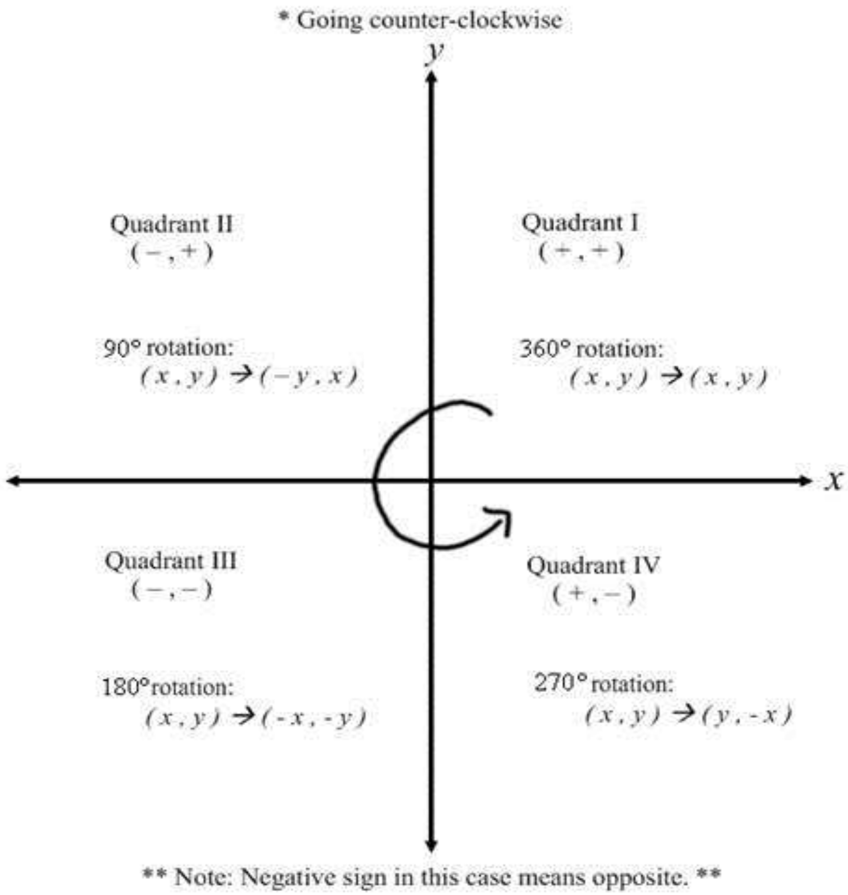
When rotating a figure counter-clockwise, remember these rules:



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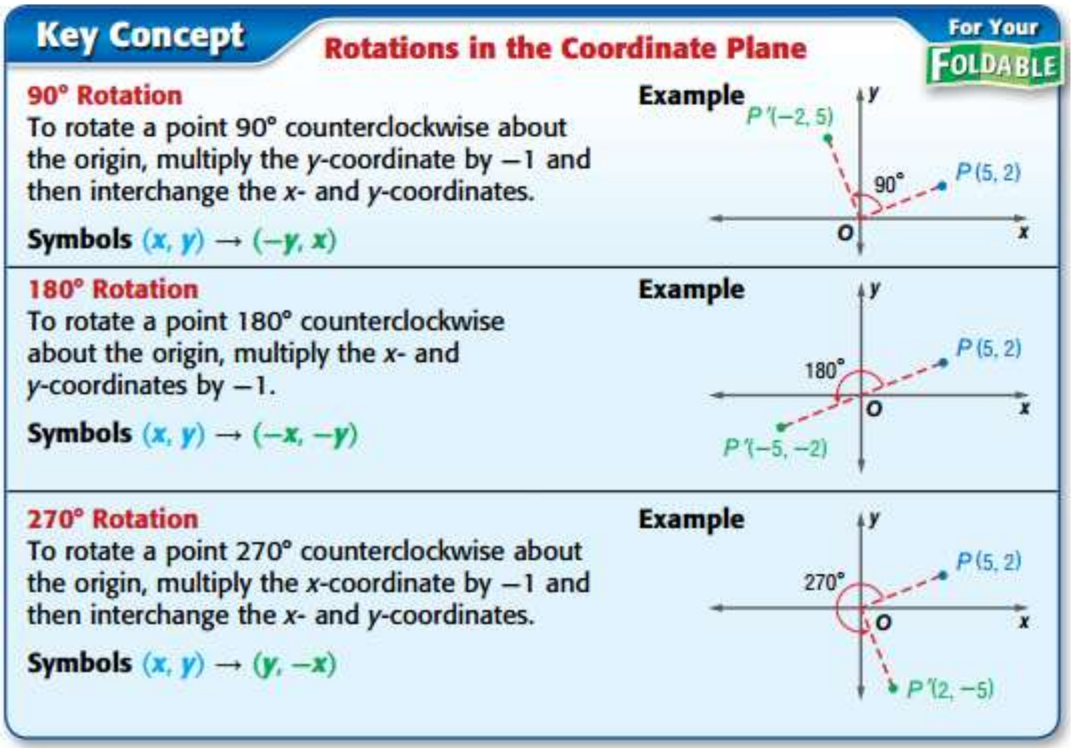

Key Concept **Rotations in the Coordinate Plane** For Your FOLDABLE

90° Rotation
To rotate a point 90° counterclockwise about the origin, multiply the *y*-coordinate by −1 and then interchange the *x*- and *y*-coordinates.

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

180° Rotation
To rotate a point 180° counterclockwise about the origin, multiply the *x*- and *y*-coordinates by −1.

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

270° Rotation
To rotate a point 270° counterclockwise about the origin, multiply the *x*-coordinate by −1 and then interchange the *x*- and *y*-coordinates.

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

CLOCKWISE AND COUNTER-CLOCK OR POSITIVE ROTATION:

1. The general rule for rotation of an object **90°** is **(x, y) → (-y, x)**. That is, swap the coordinates. Then take the opposite of y.
2. For **180°**, the rule is **(x, y) → (-x, -y).** That is, keep the coordinates, but write their opposite.
3. For **270°**, the rule is **(x, y) → (y, -x).** That is, I swap the coordinates, and then take the opposite of x.
4. For *360*◦, the rule is **(x, y)→ (x, y)**. That is, go around a full circle and return to original location.
5. Rotating an object 180◦ counter-clockwise is the same as rotating it 180◦ clockwise!
6. Rotating a figure 90◦ clockwise is the same as rotating it 270◦counter clockwise.

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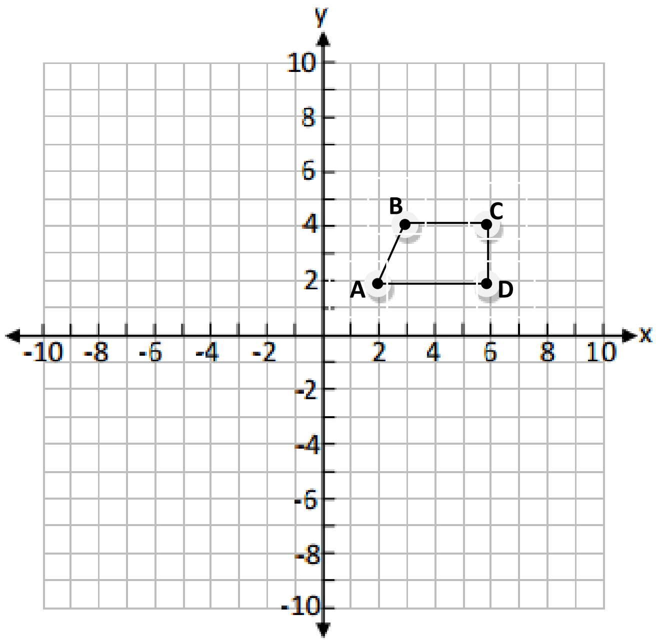
LET ME MODEL FOR YOU:

Example 1:

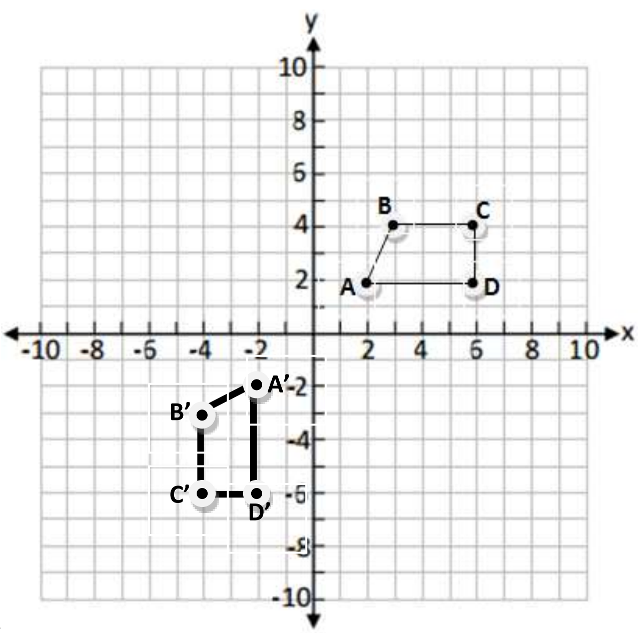
Part A:

Graph and connect these points: (2,2) (3,4) (6,2) (6,4). **Label the quadrilateral ABC.**

Solution:



Part B: Rotate triangle ABC 90° counter-clockwise about the origin, (0, 0)



Solution: 90° rotation around (0, 0). This means that

(x, y) of each vertex of the original quadrilateral (pre-image) becomes **(-y, x)** in the image of the quadrilateral**: (x, y)→(-y, x).**

Point A (2, 2) →**Point A'** (-2, 2)

Point B (3, 4) →**Point B'** (-4, 3)

Point C (6, 4) →**Point C'** (-4, 6)

Point D (6, 2) →**Point D'** (-2, 6)

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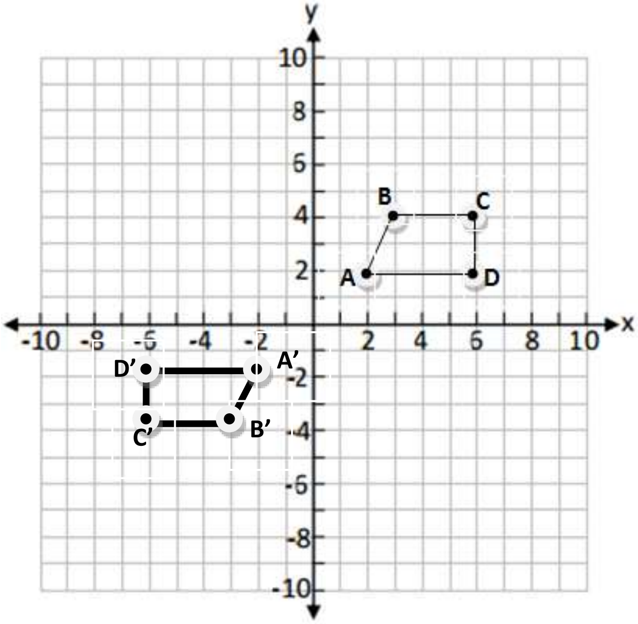
Part C: Rotate triangle ABC 180° around the origin.



Solution: 180° rotation around (0, 0). This means that

(x, y) of each vertex of the original quadrilateral (pre-image) becomes **(-x, -y)** in the image of the quadrilateral**: (x, y)→(-x, -y).**

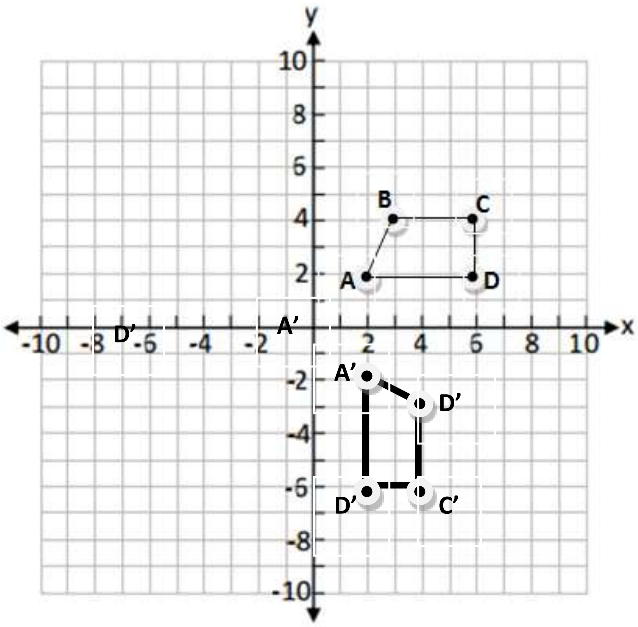
Point A (2, 2) →**Point A'** (-2, -2)

Point B (3, 4) →**Point B'** (-3, -4)

Point C (6, 4) →**Point C'** (-6, -4)

Point D (6, 2) →**Point D'** (-6, -2)

Part D: Rotate triangle ABC 270° around the origin.



Solution: A 270 rotation around the origin means that

(x, y) of each vertex of the original quadrilateral (pre-image) becomes **(y, -x)** in the image of the quadrilateral**: (x, y)→(y, -x).**

Point A (2, 2) →**Point A'** (2, -2)

Point B (3, 4) →**Point B'** (4, -3)

Point C (6, 4) →**Point C'** (4, -6)

Point D (6, 2) →**Point D'** (2, -6)

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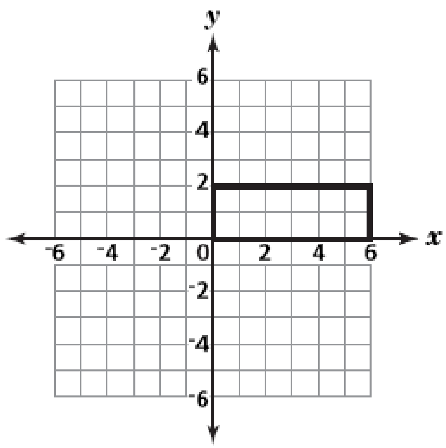
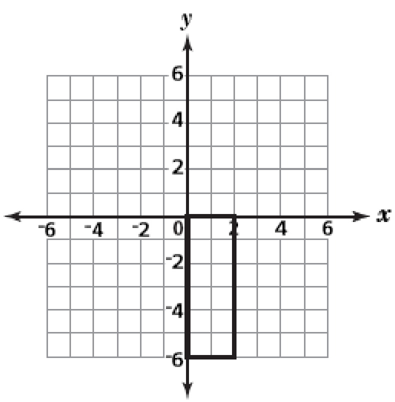
Guide Practice (We do):

A rectangle is plotted on the coordinate plane below.

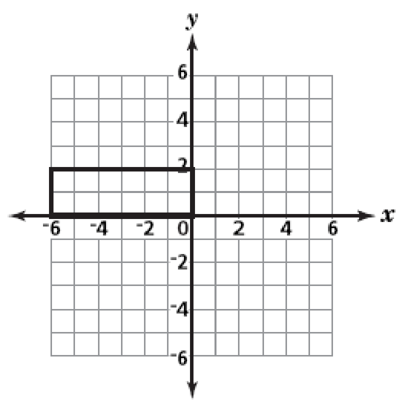


Which image shows a 90° clockwise rotation about the origin?

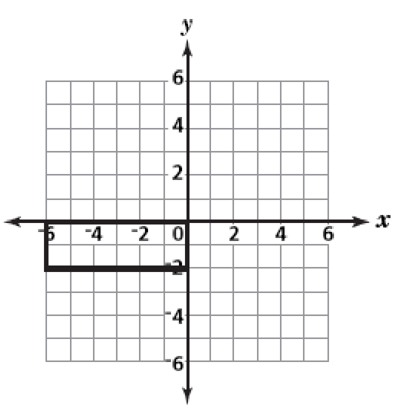
A



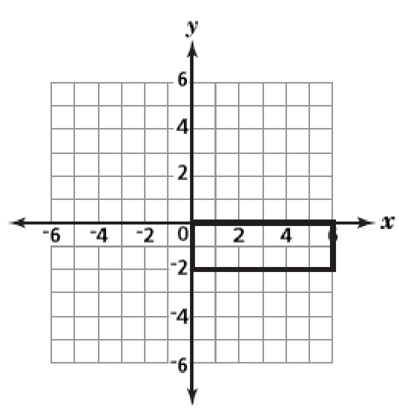
C



B



D



Solution: Rotating 90° clockwise (negative) is the same as rotating 270° counter clockwise (positive)

270° means that we take the coordinates of vertex of the rectangle, swap the coordinates, and the take the opposite of y.

(x, y) → (y, -x)

The first vertex is (0, 0) →(0, 0)

The second vertex is (0, 2) →(2, 0)

The third vertex is (6, 0) →(0, -6)

The fourth vertex is (6, 2) →(2, -6)

So the **correct answer choice is A**.

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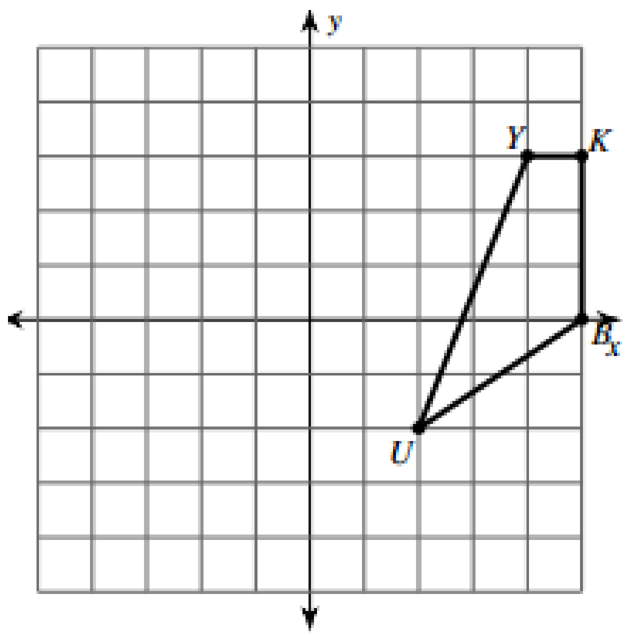
Independent Practice (You Do):

Problem 1:

Rotate polygon YKBU 90◦ counter clockwise around the origin.



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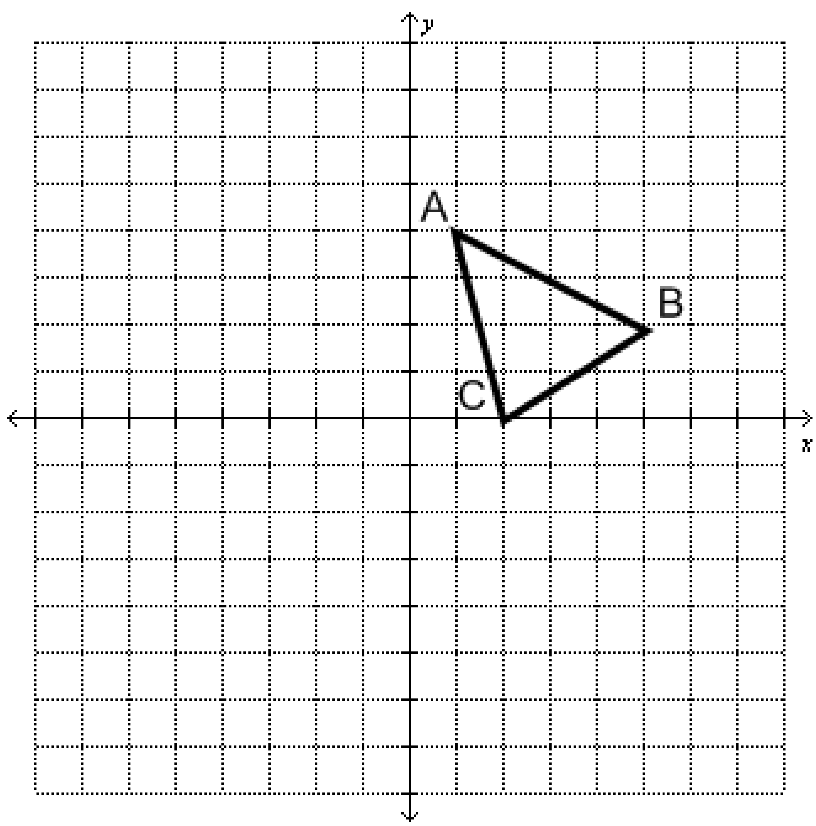
Problem 2:

Triangle *ABC* is labeled on your graph below.

a) Rotate Triangle *ABC*, 90° counterclockwise. Label the triangle *A′ B′ C′*.

b) Rotate Triangle *ABC*, 180° counterclockwise. Label the triangle *A″ B″ C″*.

c) Rotate Triangle *ABC*, 270° counterclockwise. Label the triangle *A‴ B‴ C‴*.



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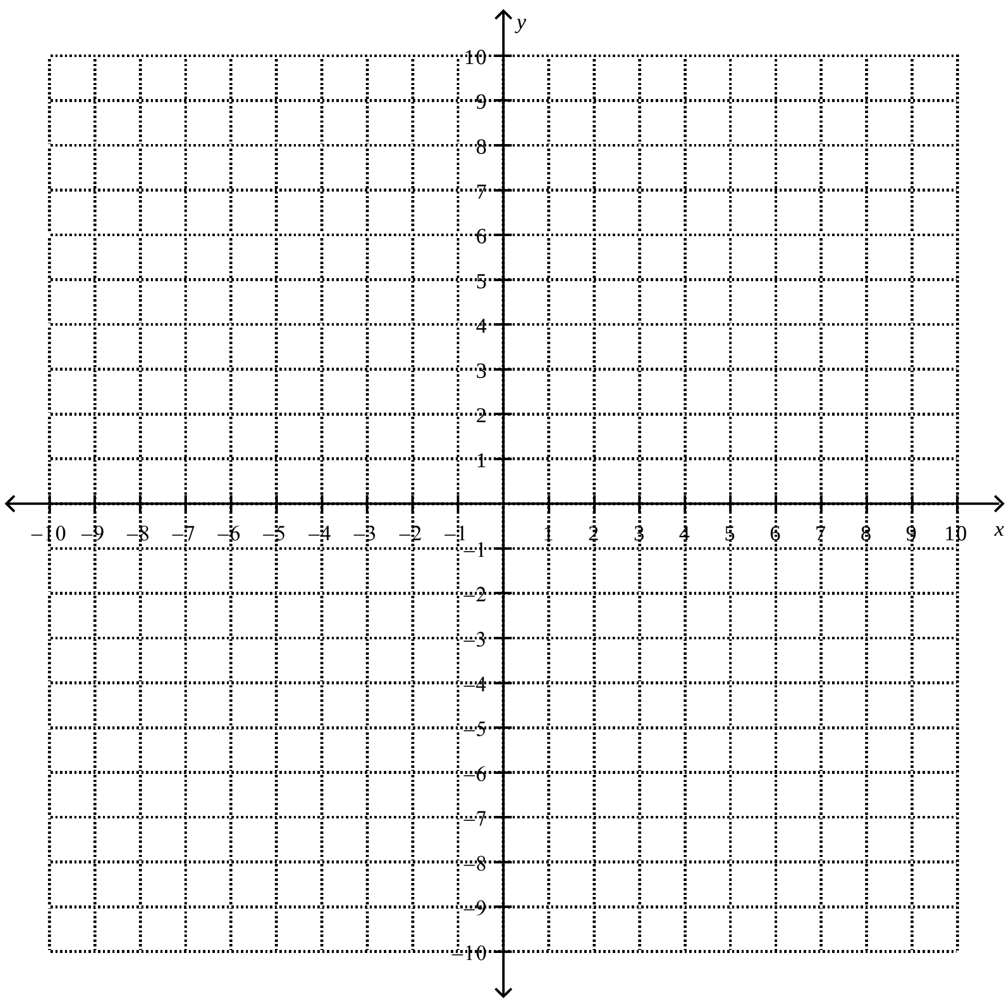
Problem 3:

Part A: Graph Triangle RST with vertices R$(2, 3)$, S $(5, 4)$, and T$(4, 8)$.

Part B: Using the rule for a rotation of 90° counterclockwise, graph Triangle $R'S'T'$ on the graph below and write the new coordinates.



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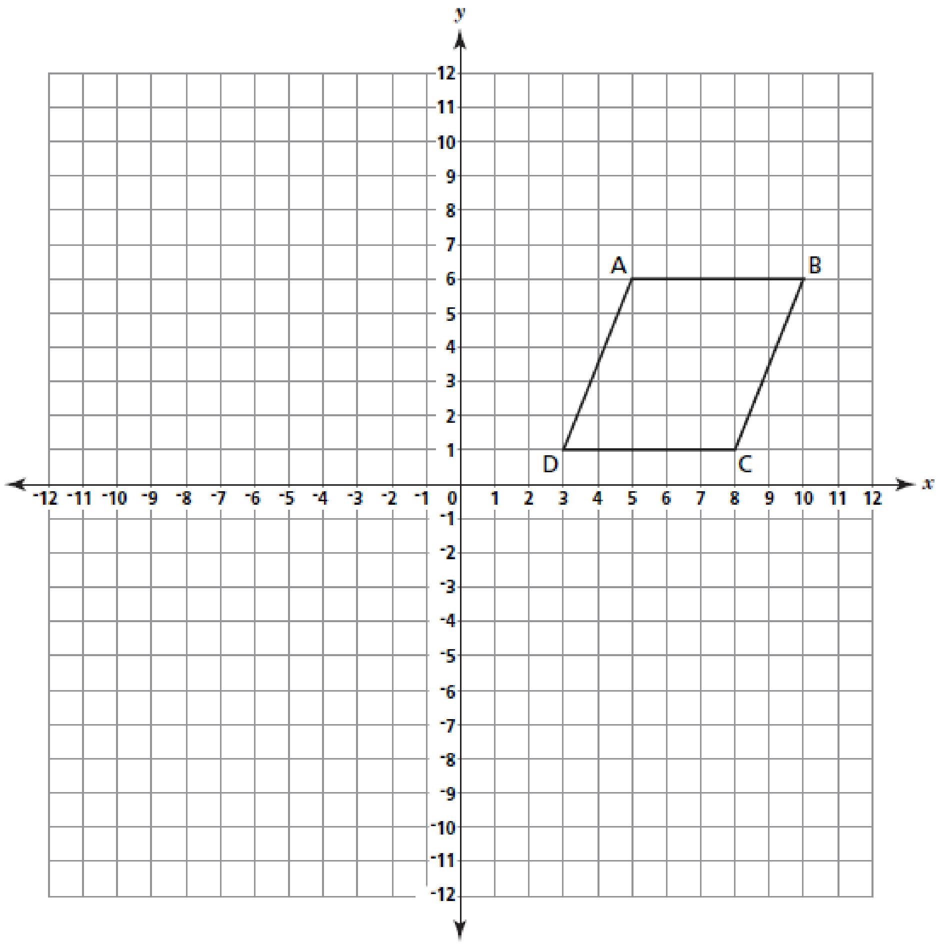
Problem 4:

Quadrilateral *ABCD* is plotted on the grid below.



Part A

On the graph, draw the image of quadrilateral *ABCD* after a counterclockwise rotation of 180° about the origin. Label the image $A'B'C'D'$.

Part B

On the lines below, explain how the coordinates of *A* changed to the coordinates of A' .

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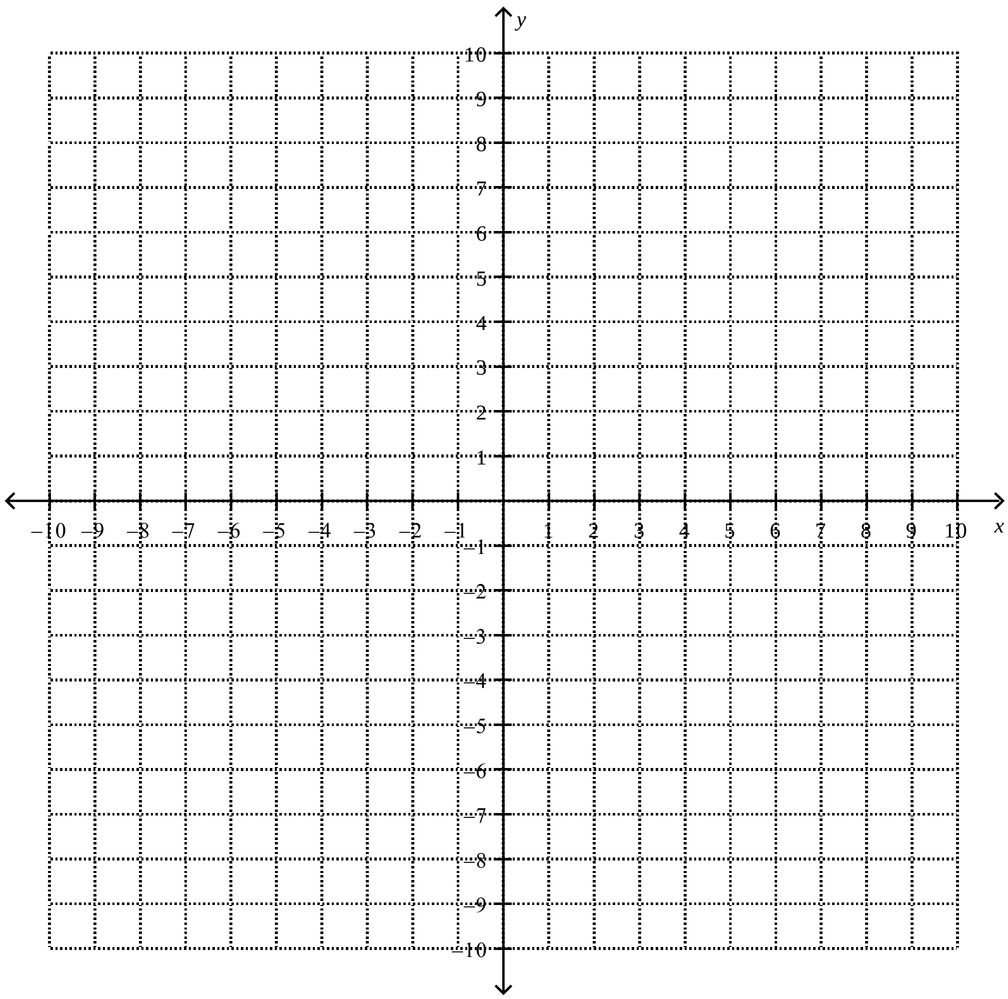
Problem 5:

Part A:

Graph Triangle RST with vertices R$(2, 3)$, S $(5, 4)$, and T$(4, 8)$.

Part B:

Using the rule for a rotation of 90° counterclockwise, graph Triangle $R'S'T'$ on the graph below and write the new coordinates.



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Problem 6:

Point *A* (3, 6) is rotated 270° counterclockwise about the origin, what is the coordinate of A' ? *Circle the best answer.*

A $(-6, 3)$

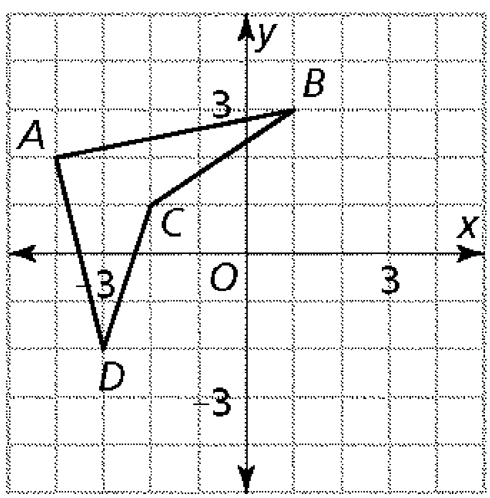
B $(6, -3)$

C $(3, 6)$

D $(-3, -6)$

Problem 7:

Draw the final image created by rotating polygon *ABCD* 90° counterclockwise about the origin and then reflecting the image in the *x*-axis.



Is the resulting image similar or congruent? How do we know?

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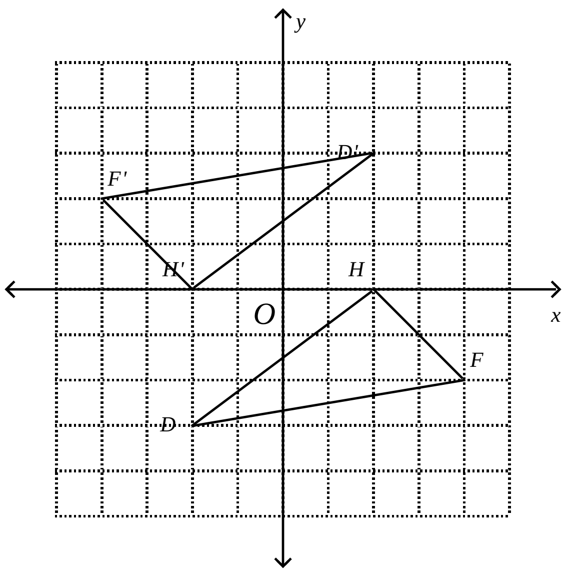
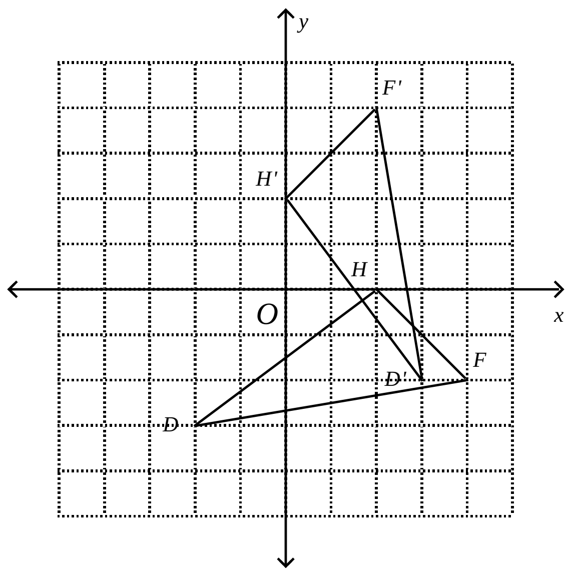
Problem 8:

Determine the transformation that produced the following images:





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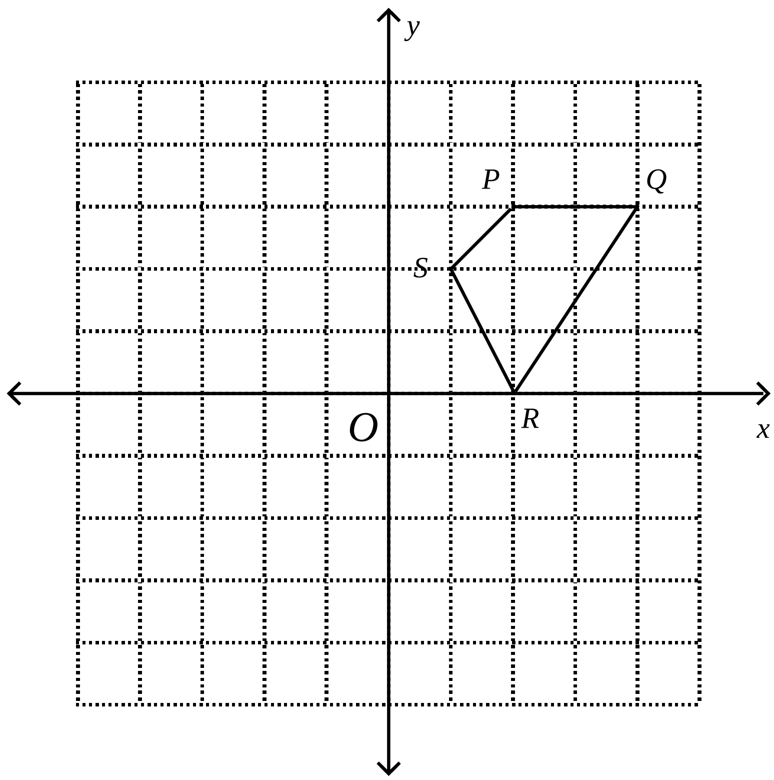
Problem 9:

Quadrilateral *PQRS* is plotted on the grid below.

On the graph, draw the image of polygon *PQRS* after a 90° clockwise rotation. Label the image *P'Q'R'S'*.



What will be the coordinates of point *Q"* after a dilation of polygon *P'Q'R'S'* using a scale factor of two?

Answer ______________

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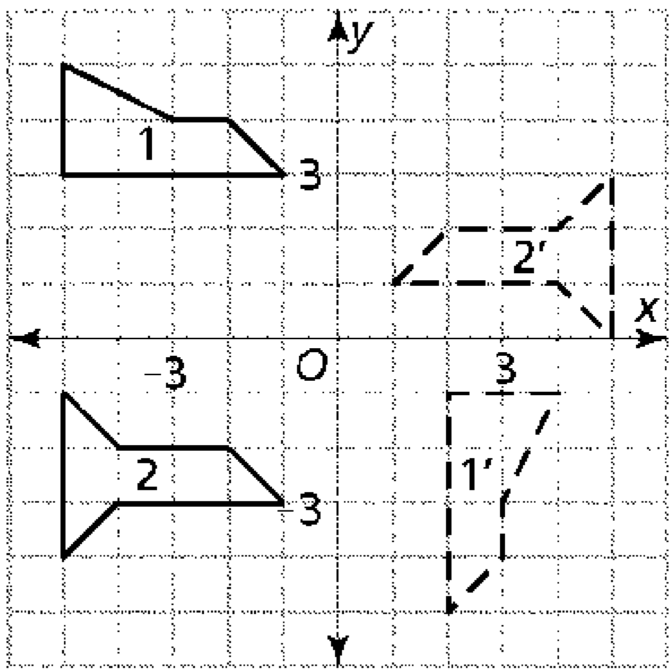
Problem 10:

Describe how you could move shape 1 to exactly match shape 1' by using series of transformations?



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Review

Problem 1:

Graph the image of quadrilateral FGHI after the following transformations. Record your coordinates in the chart after each transformation.

Transformation 1: Translation (x, y) → (x+1, y-1)

Transformation 2: Reflection across the line x = -3

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Final Summary

In a U-Shape:

1. Re-state the objective to assess if students learn it
2. Elicit from students what they have learned and what they want to learn more about.
3. Tie what they learn to the lesson, and upcoming lessons **(Next Saturday, they will learn about <u>Dilations</u>).**