Section 3: Introduction to Polygons

The following Mathematics Florida Standards will be covered in this section:	
MAFS.912.G-CO.1.1	Know precise definitions of angle, circle, perpendicular line, parallel line, and line segment, based on the undefined notions of point, line, distance along a line, and distance around a circular arc.
MAFS.912.G-CO.1.2	Represent transformations in the plane using, e.g., transparencies and geometry software; describe transformations as functions that take points in the plane as inputs and give other points as outputs. Compare transformations that preserve distance and angle to those that do not.
MAFS.912.G-CO.1.3	Given a rectangle, parallelogram, trapezoid, or regular polygon, describe the rotations and reflections that carry it onto itself.
MAFS.912.G-CO.1.4	Develop definitions of rotations, reflections, and translations in terms of angles, circles, perpendicular lines, parallel lines, and line segments.
MAFS.912.G-CO.1.5	Given a geometric figure and a rotation, reflection, or translation, draw the transformed figure. Specify a sequence of transformations that will carry a given figure onto itself.

MAFS.912.G-CO.2.6	Use geometric descriptions of rigid motions to transform figures and to predict the effect of a given rigid motion on a given figure; given two figures, use the definition of congruence in terms of rigid motions to decide if they are congruent.
MAFS.912.G-MG.1.1	Use geometric shapes, their measures, and their properties to describe objects.
MAFS.912.G-SRT.1.1	Verify experimentally the properties of dilations given by a center and a scale factor. A dilation takes a line not passing through the center of the dilation to a parallel line and leaves a line passing through the center unchanged. The dilation of a line segment is longer or shorter in the ratio given by the scale factor.
MAFS.912.G-SRT.1.2	Given two figures, use the definition of similarity in terms of similarity transformations to decide if they are similar; explain using similarity transformations the meaning of similarity for triangles as the equality of all corresponding pairs of angles and the proportionality of all corresponding pairs of sides.
MAFS.912.G-SRT.2.5	Use congruence and similarity criteria for triangles to solve problems and to prove relationships in geometric figures.

Videos in this Section

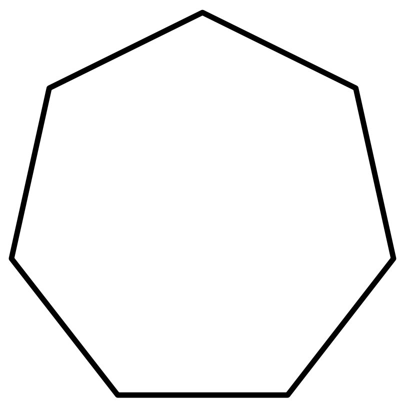
Video 1: Introduction to Polygons
Video 2: Angles of Polygons
Video 3: Translation of Polygons
Video 4: Reflection of Polygons
Video 5: Rotation of polygons – Part 1
Video 6: Rotation of Polygons – Part 2
Video 7: Dilation of Polygons – Part 1
Video 8: Dilation of Polygons – Part 2
Video 9: Compositions of Transformations of Polygons
Video 10: Symmetries of Regular Polygons
Video 11: Congruence and Similarity of Polygons

Section 3 – Video 1
Introduction to Polygons

The word polygon can be split into two parts:

- "poly-" means _____________.
- "gon" means ______________.

Consider the polygon below.



Are polygons closed or open figures? Explain your answer.

How many sides does a polygon have?

The ***interior angles of a polygon*** are the angles on the inside of the polygon formed by each pair of adjacent sides.

Label the interior angles of the polygon above.

An ***exterior angle of a polygon*** is an angle that forms a linear pair with one of the interior angles of the polygon.

Label the exterior angels of the polygon on the previous page.

Draw a representation of each of the polygons below.

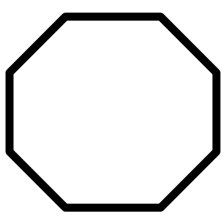
Name	**Definition**	**Representation**
Regular	All angles and sides of this polygon are congruent.	
Irregular	All angles and sides of this polygon are not congruent.	
Convex	This polygon has no angles pointing inwards. That is, no interior angles can be greater than $180°$.	
Concave	This polygon has an interior angle greater than $180°$.	
Simple	This polygon has one boundary and doesn't cross over itself.	
Complex	This polygon intersects itself.	

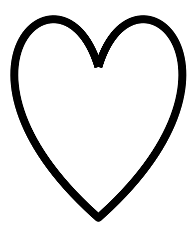
We can also classify a polygon by the number of sides.

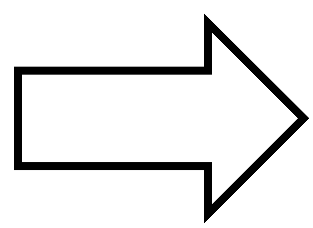
# Sides	Names	# Sides	Names
3		8	
4		9	nonagon
5	pentagon	10	
6		11	hendecagon
7	heptagon	12	dodecagon

Let's Practice!

Determine whether the following shapes are polygons. Classify the polygons by their number of sides.







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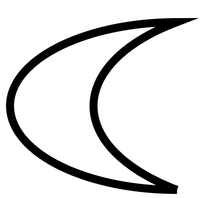
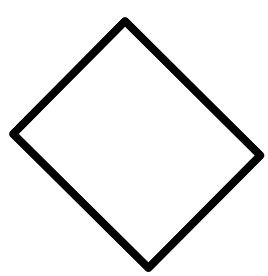
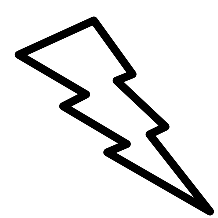






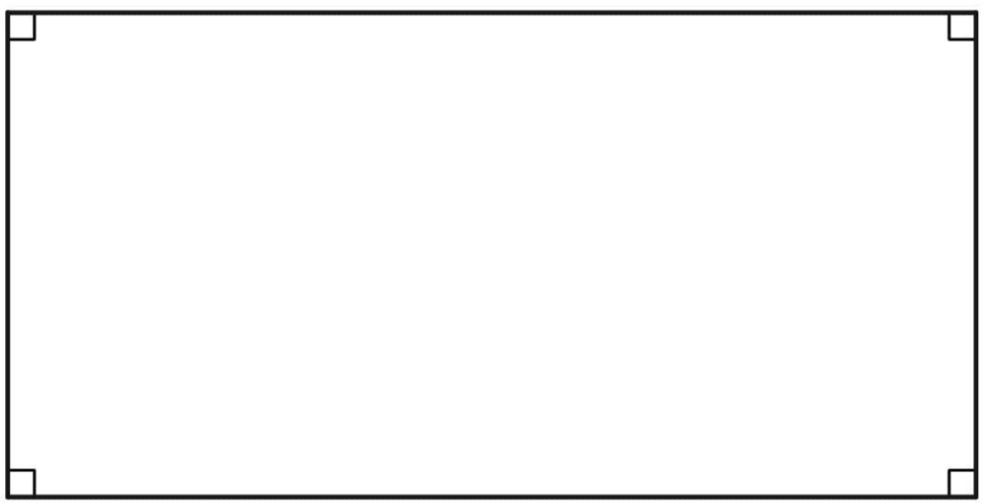
______________________ ______________________ ______________________

Let's discover some facts about angle measures of polygons.

How many sides does a triangle have?

What is the sum of the interior angles of a triangle?

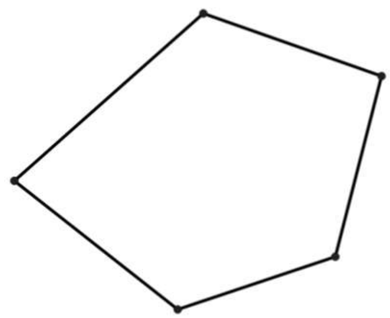
Consider the quadrilateral below.



How many sides does a quadrilateral have?

Use your knowledge of triangles to find the sum of the interior angles of the quadrilateral.

Consider the pentagon below.



How many sides does a pentagon have?

Use your knowledge of triangles to find the sum of the interior angles of the pentagon.

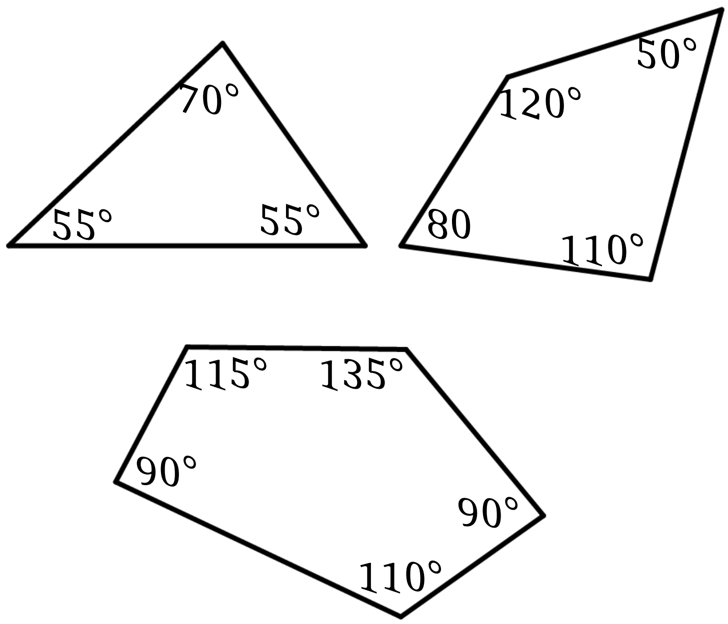
Try it!

Use what you discovered in the previous activities to complete the table below.

Number of sides	Sum of interior angles
3	
4	
5	
6	
7	
n	

Let's Practice!

Consider each of the following polygons. Find the sum of the exterior angles in each polygon below.



The sum of the exterior angles of any polygon equals _______.

Try It!

A convex pentagon has exterior angles with measures $66°$, $77°$, $82°$ and $62°$.

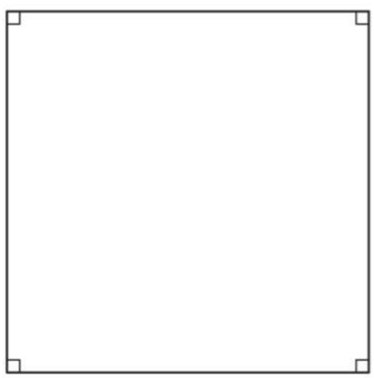
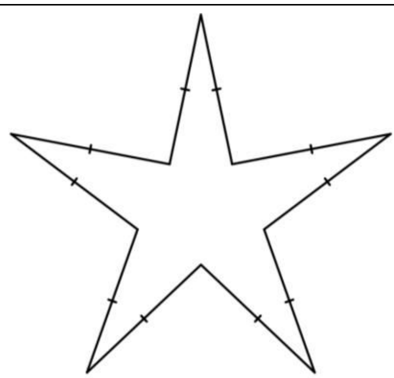
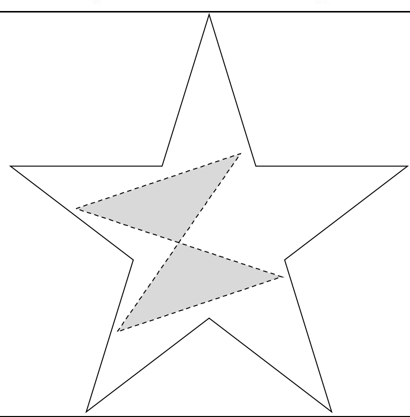
Part A: Draw a representation of the above pentagon.

Part B: What is the measure of an exterior angle of the pentagon at the fifth vertex?

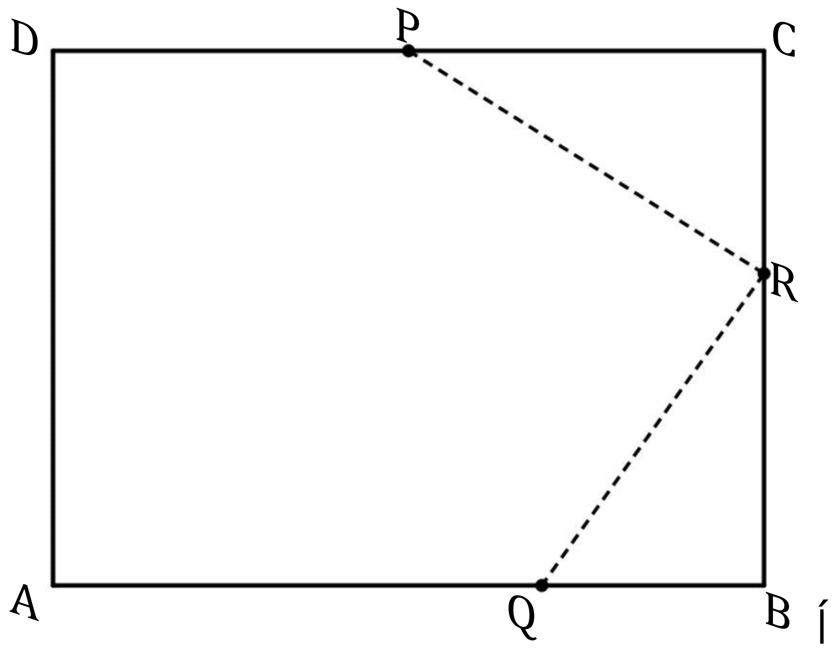
Part C: Classify the pentagon as regular or irregular. Justify your answer.

BEAT THE TEST!

1. Eddie has a piece of paper that he cuts into different shapes. The table below shows the piece of paper in the first row and then, each figure he made, represented by dashed lines and gray shading in the other rows. Classify each figure as regular, concave, and/or complex by marking the appropriate box. Name each kid of polygon represented by filling in each blank provided.

Figure	Regular	Concave	Complex	Name the Polygon
	☐	☐	☐	________________
	☐	☐	☐	________________
	☐	☐	☐	________________

2. Consider the figure below. Moses cut rectangle $ABCD$ into pentagon $AQRPD$.



If $m\angle PRQ = 71°$ and $m\angle PRC \cong m\angle QRB$, verify the sum of the interior angles of pentagon $AQRPD$ using two different methods. Justify your answers.

Section 3 – Video 2
Angles of Polygons

In the previous video, you learned the formula to find the sum of the angles of a polygon.

How can you use the sum of interior angles formula to find the number of sides of a polygon?

How can you use the sum of interior angles formula to find the measure one angle of a regular polygon?

Can the same process be used to find the measure of one angle of an irregular polygon? Explain your reasoning.

Let's Practice!

What are the measures of each interior angle and each exterior angle of regular hexagon $MARLON$?

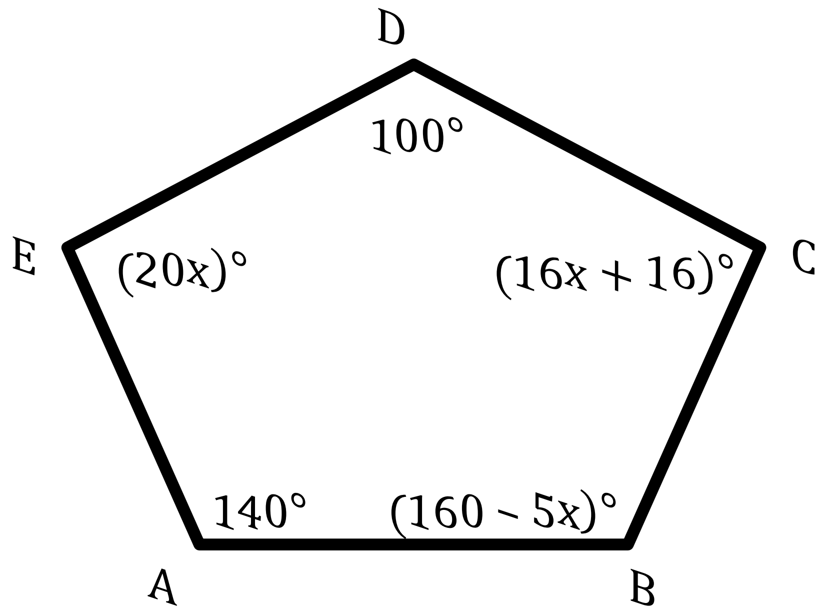
The sum of the interior angles of a regular polygon is $1080°$.

Part A: Classify the polygon by the number of sides.

Part B: What is the measure of one interior angle of the polygon?

Part C: What is the measure of one exterior angle of the polygon?

Consider pentagon $ABCDE$.



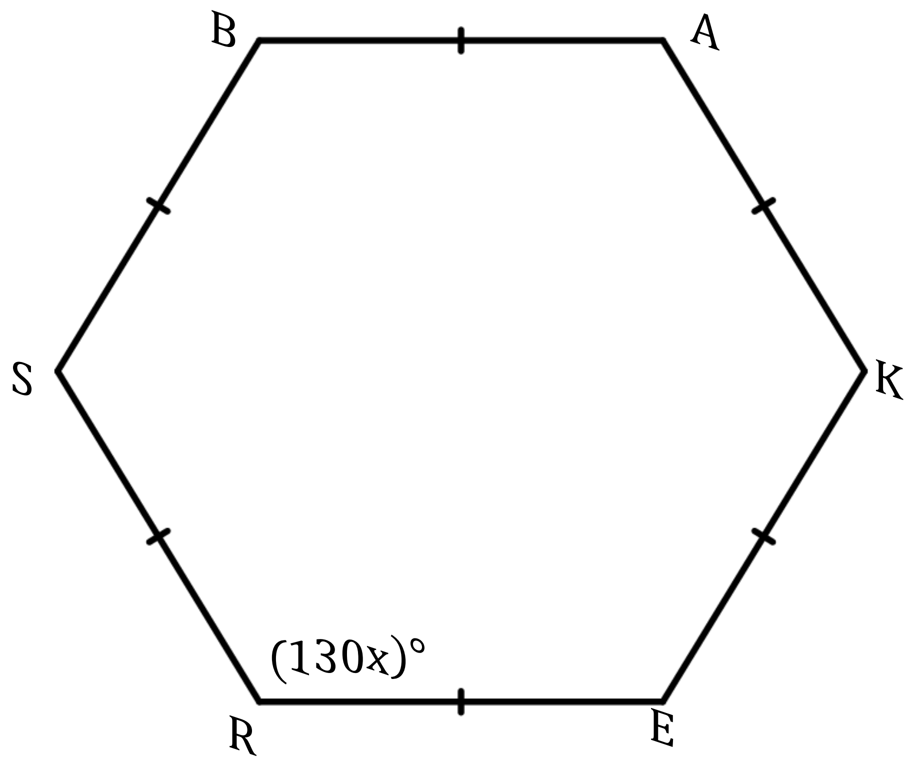
Part A: Find the value of x.

Part B: Find the value of each $\angle A$, $\angle B$, $\angle C$, $\angle D$, and $\angle E$.

Part C: Find the value of each exterior angle.

Try it!

Consider the regular hexagon below.



Part A: Find the value of x.

Part B: Find the value of each interior angle.

Part C: Find the value of each exterior angle.

If the measure of an exterior angle of a regular polygon is 24°, how many sides does the polygon have?

Given a regular decagon and a regular dodecagon, which one has a greater exterior angle? By how much is the angle greater?

BEAT THE TEST!

1. A teacher showed the following exit ticket on the projector.

> 1. What is the sum of the interior angle measures of a regular 24-gon?
> 2. Pentagon ABCDE has interior angles that measure 60 and 160 and another pair of interior angles that measure 130. What is the measure of an interior angle at the fifth vertex?

A student completed the following exit ticket.

1) $\text{Sum} = \frac{(n-2)180}{n}$

$= \frac{(24-2)180}{24}$

$= \frac{(22)180}{24}$

$= 165$

2) $130 + 60 + 160 + x = (5-2)180$

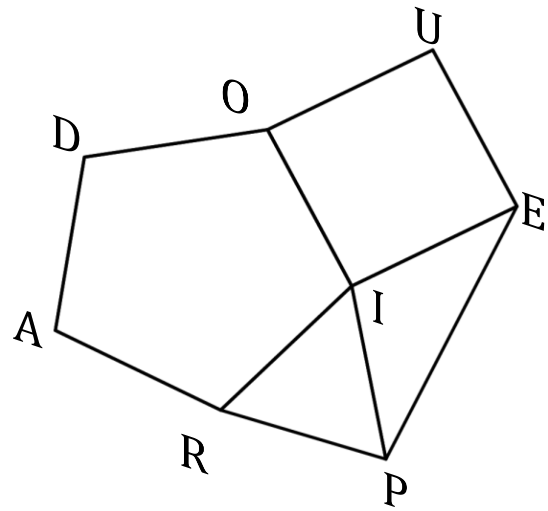
$350 + x = 540$

$x = 190$

Which of the following statements is true?

- o Both answers are correct.
- o Answer #1 is incorrect. The student found the individual angle, not the sum of the angles. The answer should be $3960°$. Answer #2 is correct.
- o Answer #1 is correct. Answer #2 is incorrect. There are two angles measuring $130°$, but only one was counted in the sum. The answer should be $60°$.
- o Both answers are incorrect. In #1 the student found the individual angle, not the sum of the angles. The answer is $3960°$. In #2 there are two angles measuring $130°$, but only one was counted in the sum. The answer should be $60°$.

2. Consider the figure below.



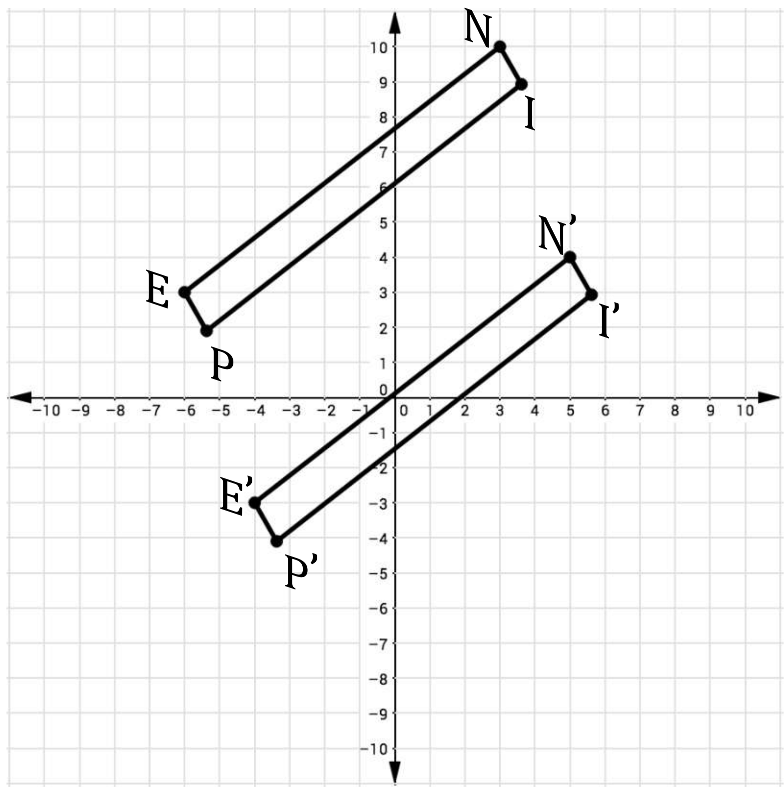
$DARIO$ is a regular pentagon, RIP is an equilateral triangle, and $EIOU$ is a square.

What is the measure of $\angle IPE$?

What is the measure of exterior angle $\angle DOU$?

Section 3 – Video 3
Translations of Polygons

Describe the translation of rectangle $PINE$.



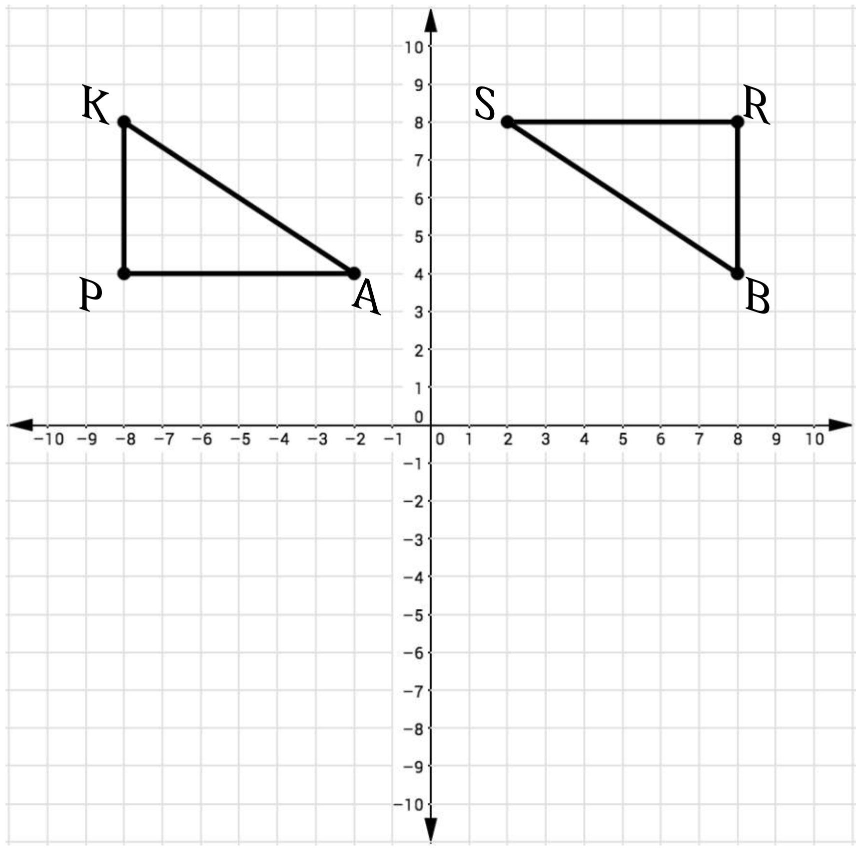
- The original object and its image are _______________.

- In other words, the two objects are identical in every respect except for their _____________.

Draw line segments linking a vertex in the original image to the corresponding vertex in the translated image. Make observations about the line segments.

Let's Practice!

Consider the two right triangles below.



Rectangle $PARK$ is formed when right triangles PAK and RSB are translated. $PARK$ has vertices at $P(-8,-8)$, $A(-2,-8)$, $R(-2,-4)$, and $K(-8,-4)$.

Describe how rectangle $PARK$'s location on the coordinate plane is possible with only one translation for PAK and one translation for RSB.

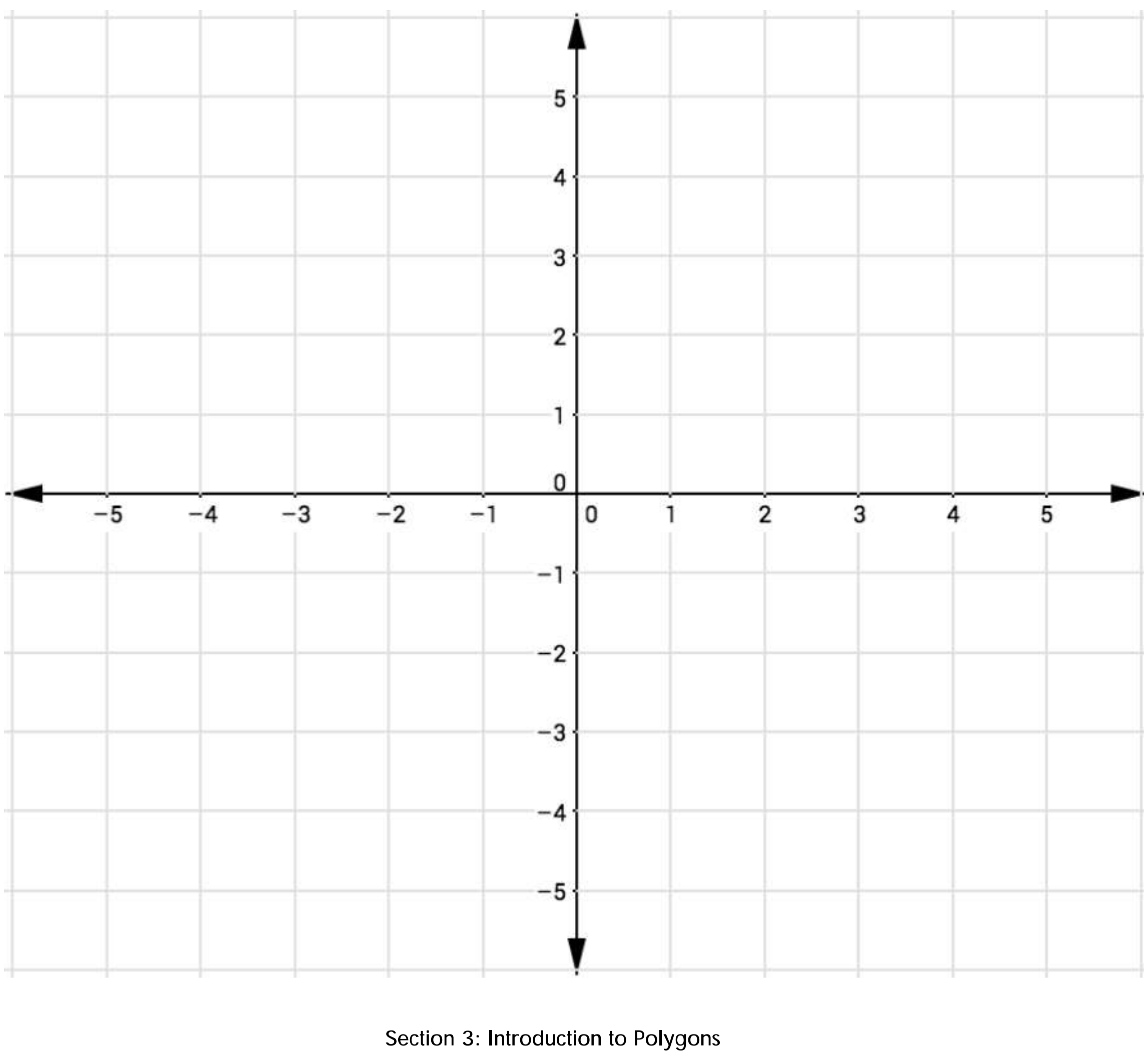
Try it!

$C(0,-1),\ A(-2,2),\ M(2,4),\ P(3,0)$ is translated $(x-2, y-1)$.

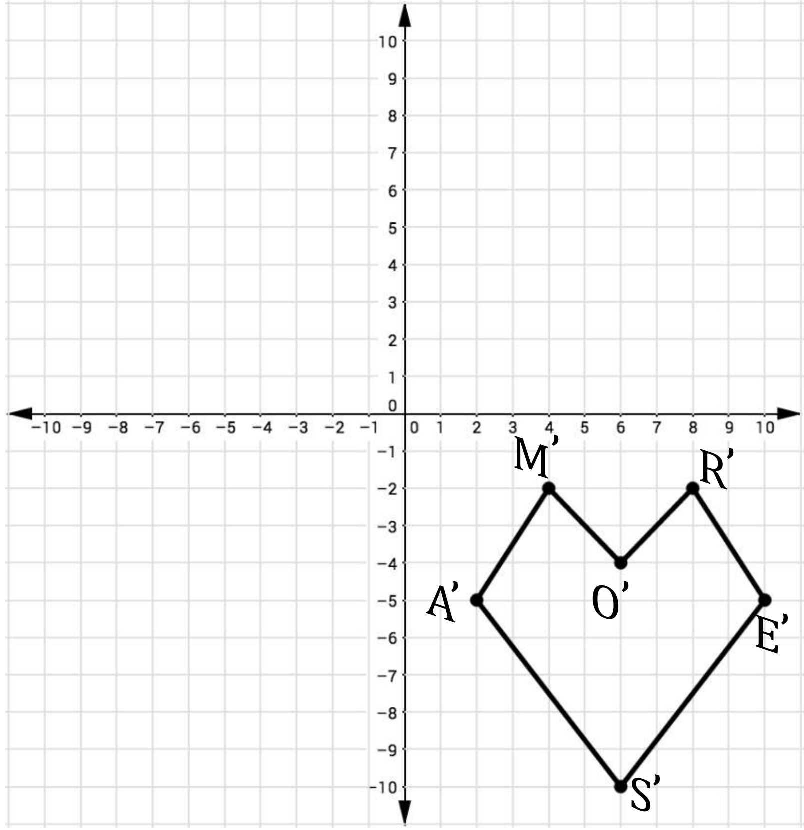
Part A: What is the x – coordinate of A'?

Part B: What is the y – coordinate of P'?

Part C: Show the translation on the coordinate plane below.



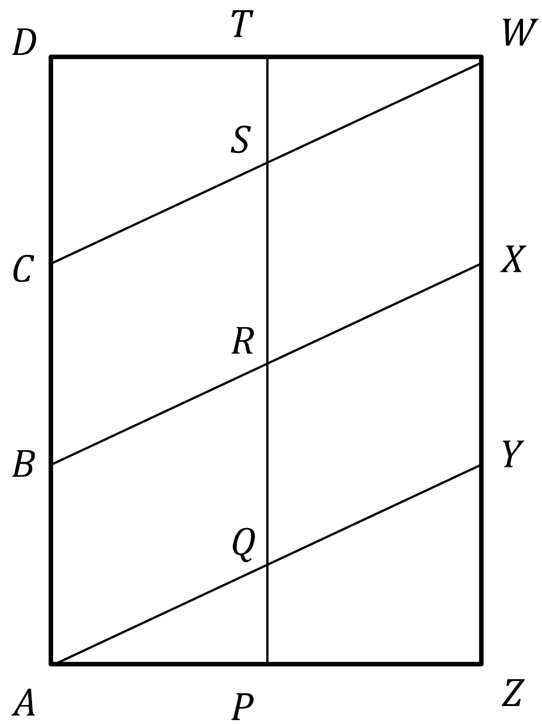
Polygon $A'M'O'R'E'S'$ is the image of polygon $AMORES$ after a translation $(x+8, y-7)$.



What are the original coordinates of each point of polygon $AMORES$?

BEAT THE TEST!

1. Consider the figure below.



If R is the image of A after a translation, then which point is the image of Q under the same translation?

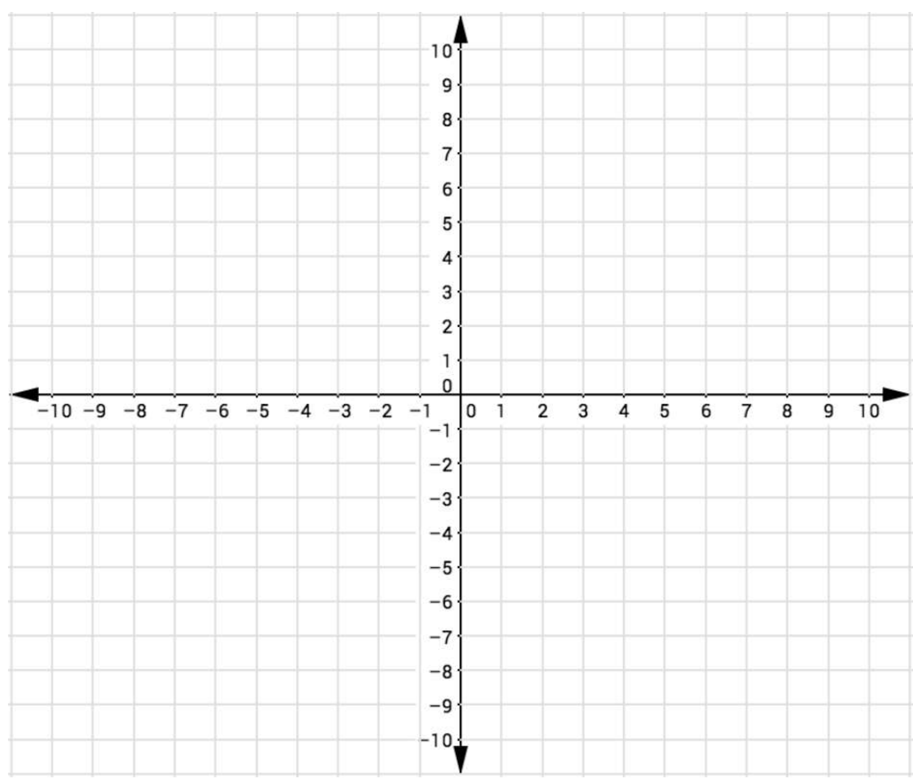
Section 3 – Video 4
Reflections of Polygons

Think back to what you know about reflections to answer the questions below.

What are the mirror lines? Draw representation of a mirror line.

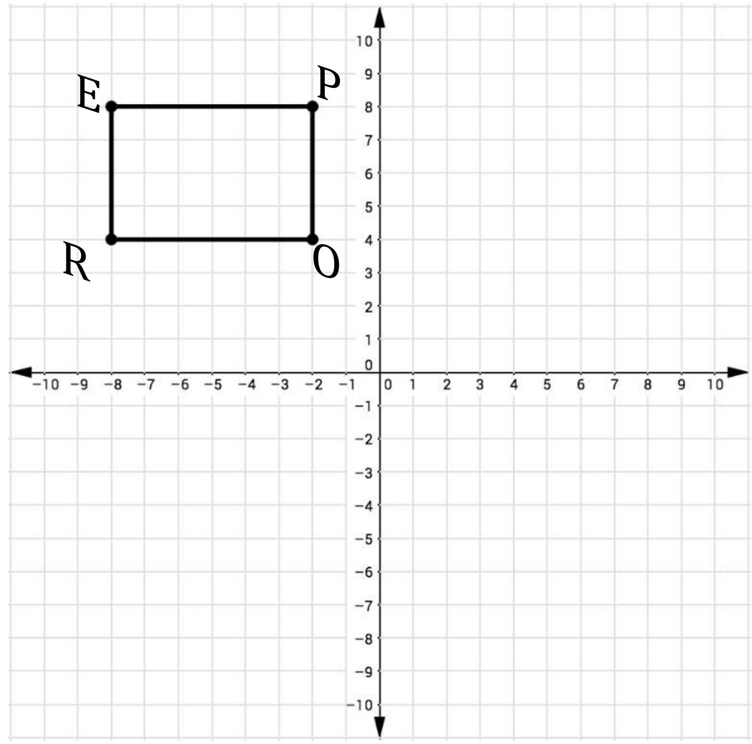
What is a mirror point? Draw representation of a mirror point.

What are the most common mirror point(s) and line(s)?



Let's Practice!

Consider rectangle $ROPE$ on the coordinate plane.

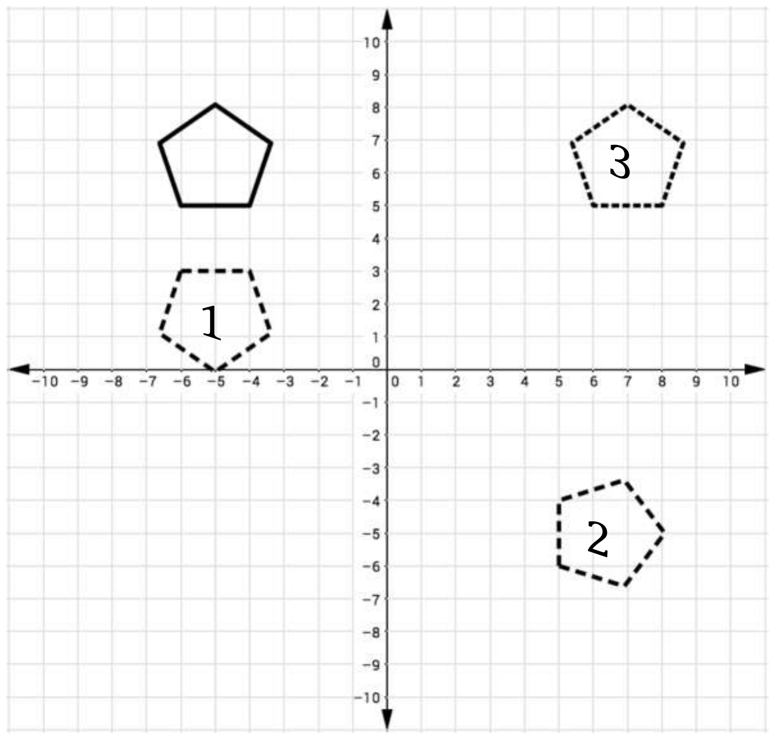


Part A: Draw a reflection over the x – axis. Write down the coordinates of the reflected figure.

Part B: Draw a reflection over the y – axis. Write down the coordinates of the reflected figure.

Try it!

The pentagon was reflected three different times and resulted in the dashed pentagons labeled as $1, 2,$ and 3.

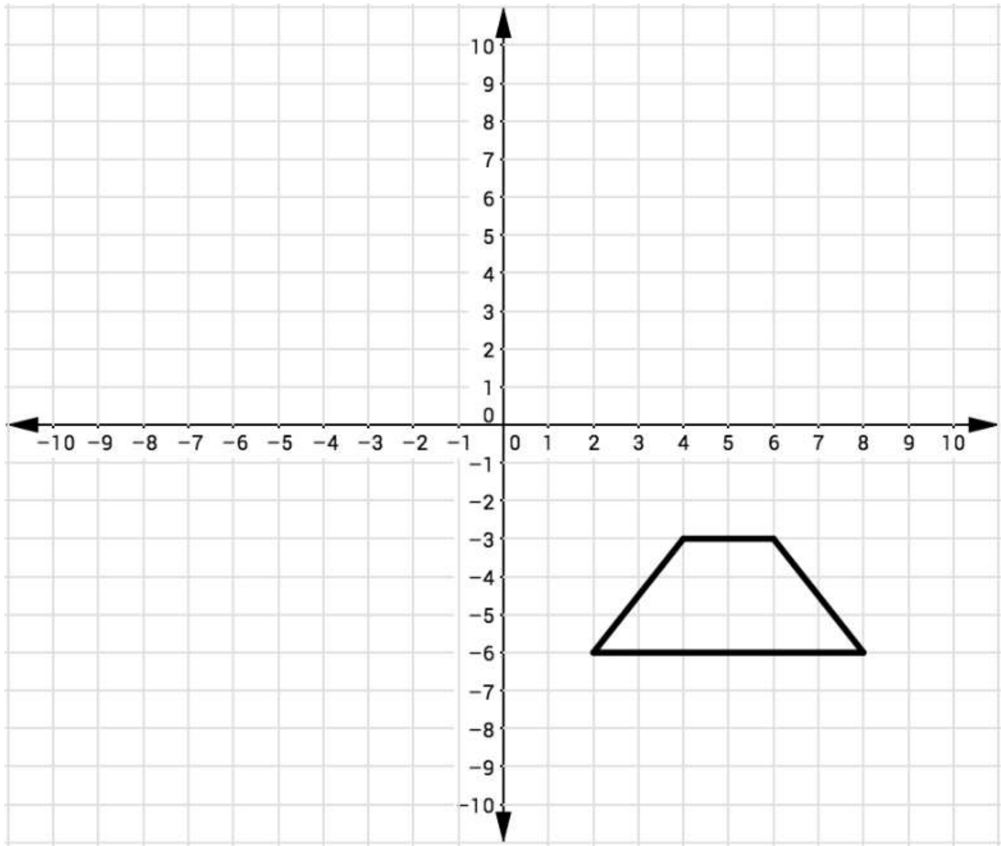


Describe each reflection by completing each section of the table below.

Reflection 1	Reflection 2	Reflection 3

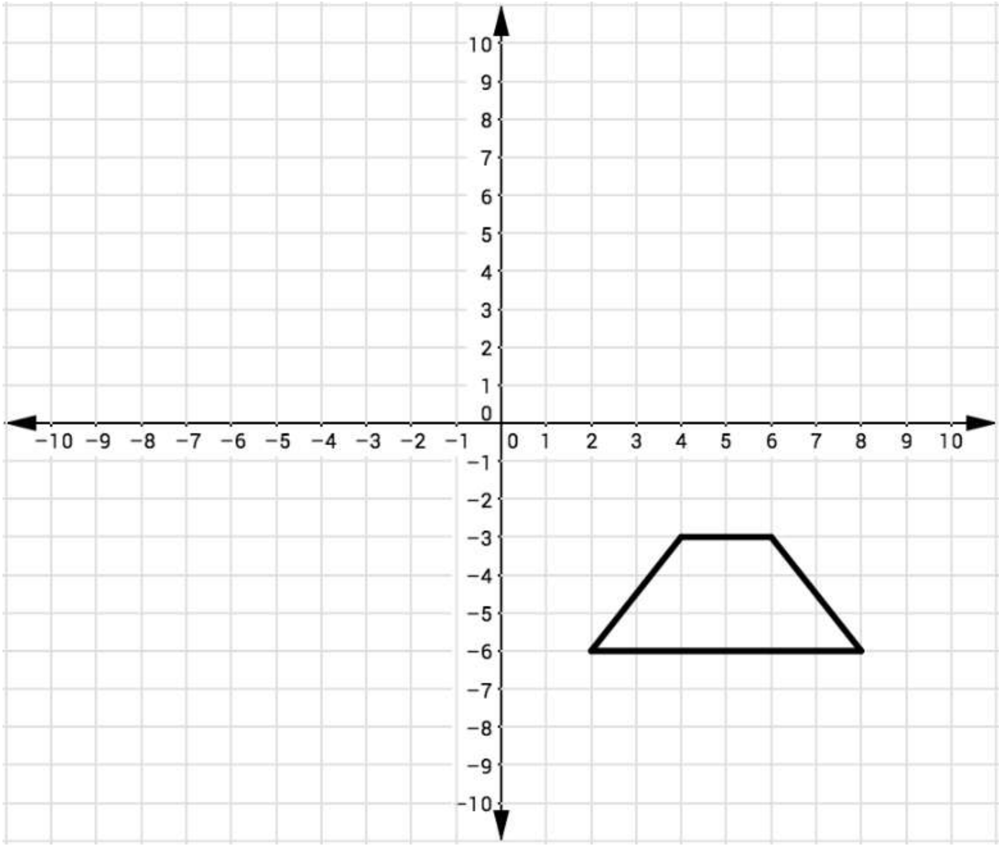
Let's Practice!

Reflect the following image over $y = x$.



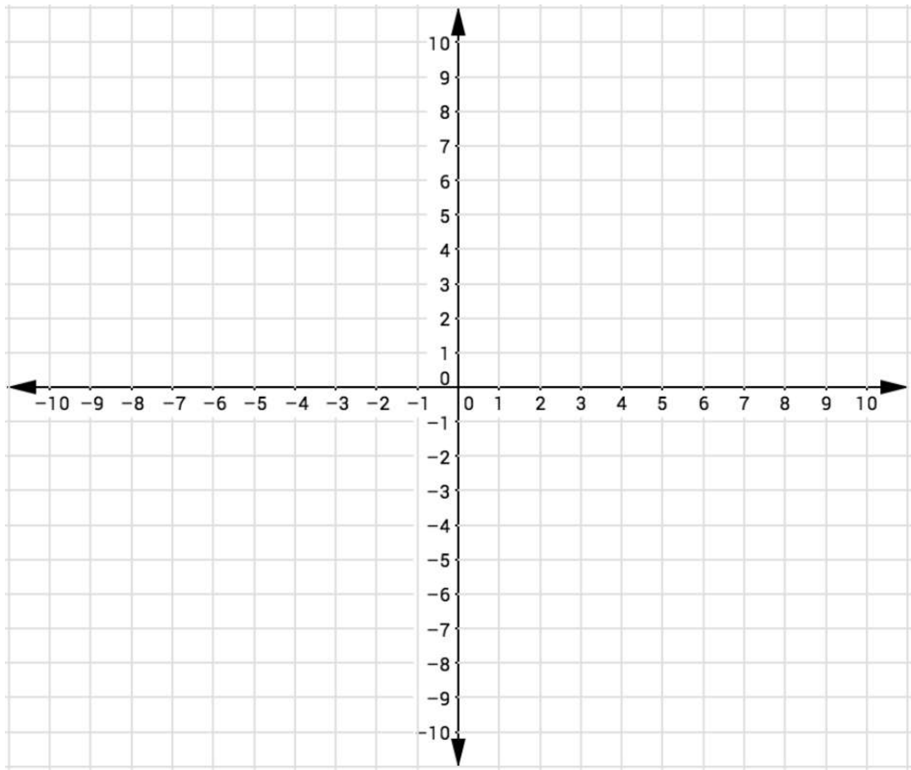
Try It!

Reflect the following image over $y = -x$.



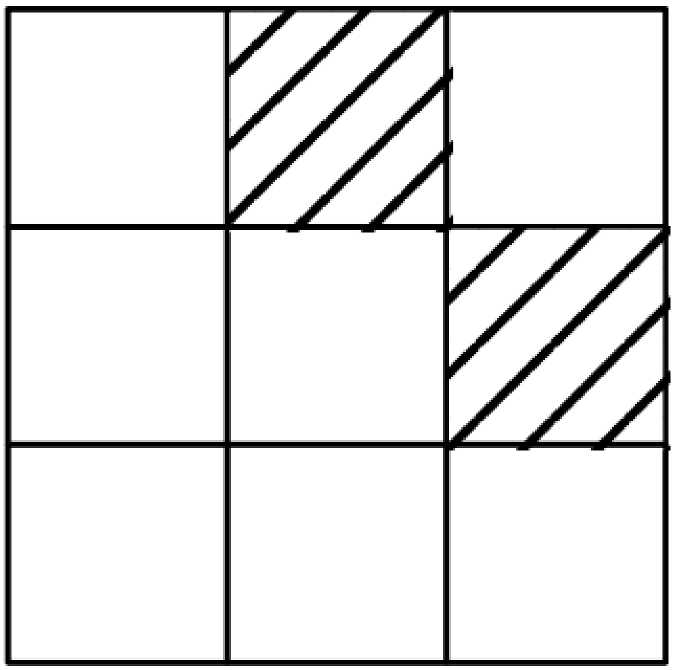
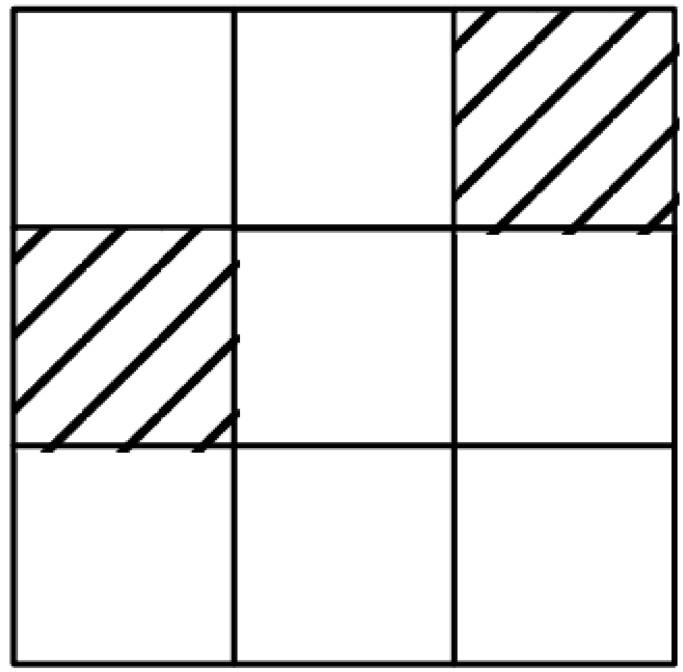
What are the similarities and differences between reflecting over the axis and reflecting over other linear functions?

Pentagon $CALOR$ is the result of a reflection of pentagon $FRISA$ over $y = x$. $CALOR$ has vertices at $C(2, -2), A(0, -4)$, $L(1, -6)$, $O(3, -6)$, and $R(4, -4)$. In which quadrant was pentagon $FRISA$ located before being reflected to create $CALOR$?



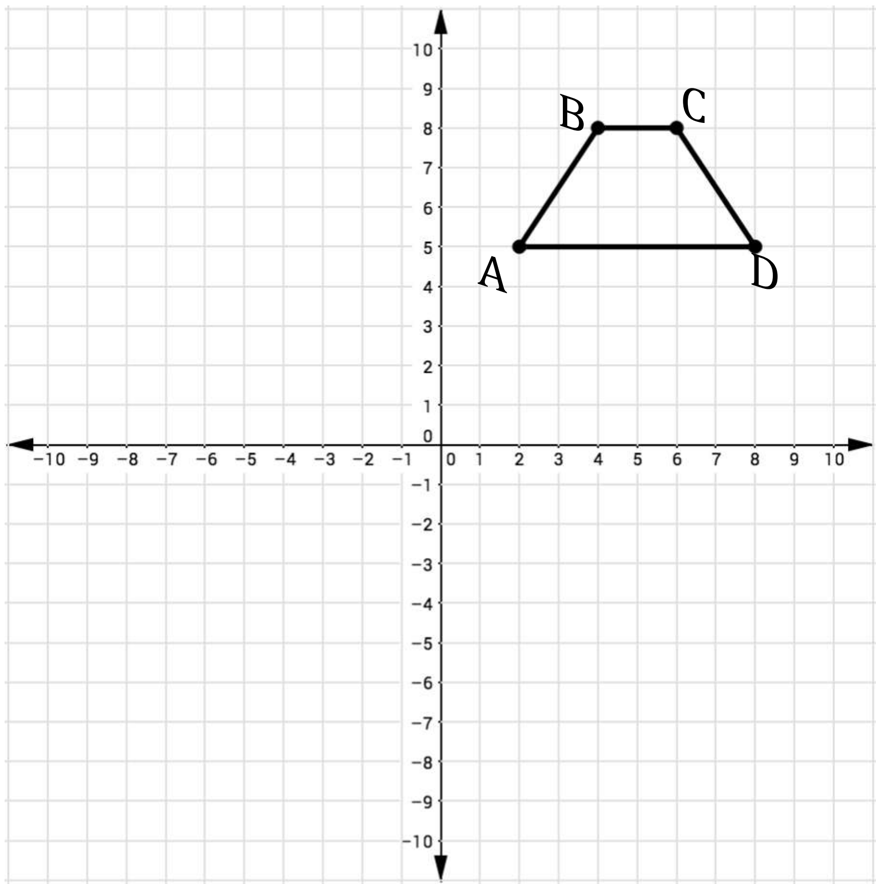
BEAT THE TEST!

1. Draw the line(s) of reflection of the following figures.

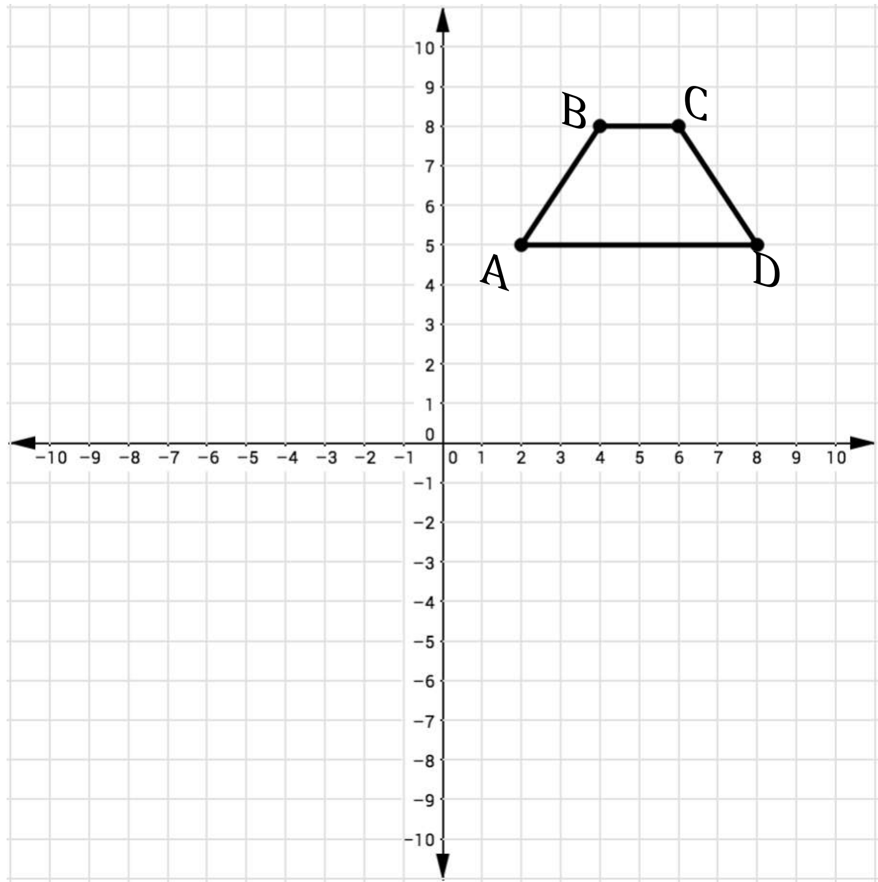
Section 3 – Video 5
Rotation of Polygons – Part 1

Consider polygon $ABCD$ and the transformed polygon that is rotated $90°$, $180°$, $270°$, and $360°$ clockwise about the origin.



Vertices of $ABCD$	Vertices of $90°$ rotation	Vertices of $180°$ rotation	Vertices of $270°$ rotation	Vertices of $360°$ rotation
$(2, 5)$				
$(4, 8)$				
$(6, 8)$				
$(8, 5)$				

Consider polygon $ABCD$ and the transformed polygon that is rotated $90°$, $180°$, $270°$, and $360°$ counterclockwise about the origin.



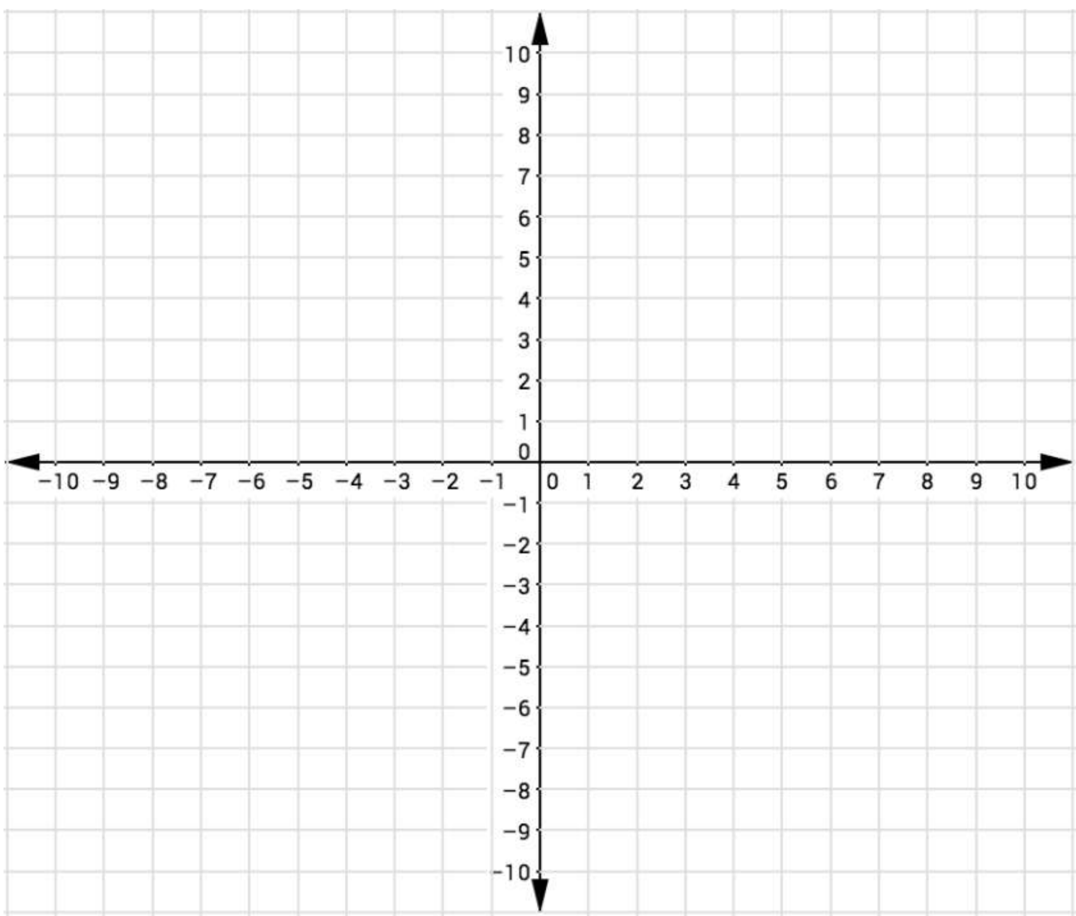
Vertices of $ABCD$	Vertices of $90°$ rotation	Vertices of $180°$ rotation	Vertices of $270°$ rotation	Vertices of $360°$ rotation
$(2, 5)$				
$(4, 8)$				
$(6, 8)$				
$(8, 5)$				

The coordinates (x, y) of any polygon that is rotated in the following methods will become:

Rotation	Clockwise	Counterclockwise
$90°$		
$180°$		
$270°$		
$360°$		

Let's Practice!

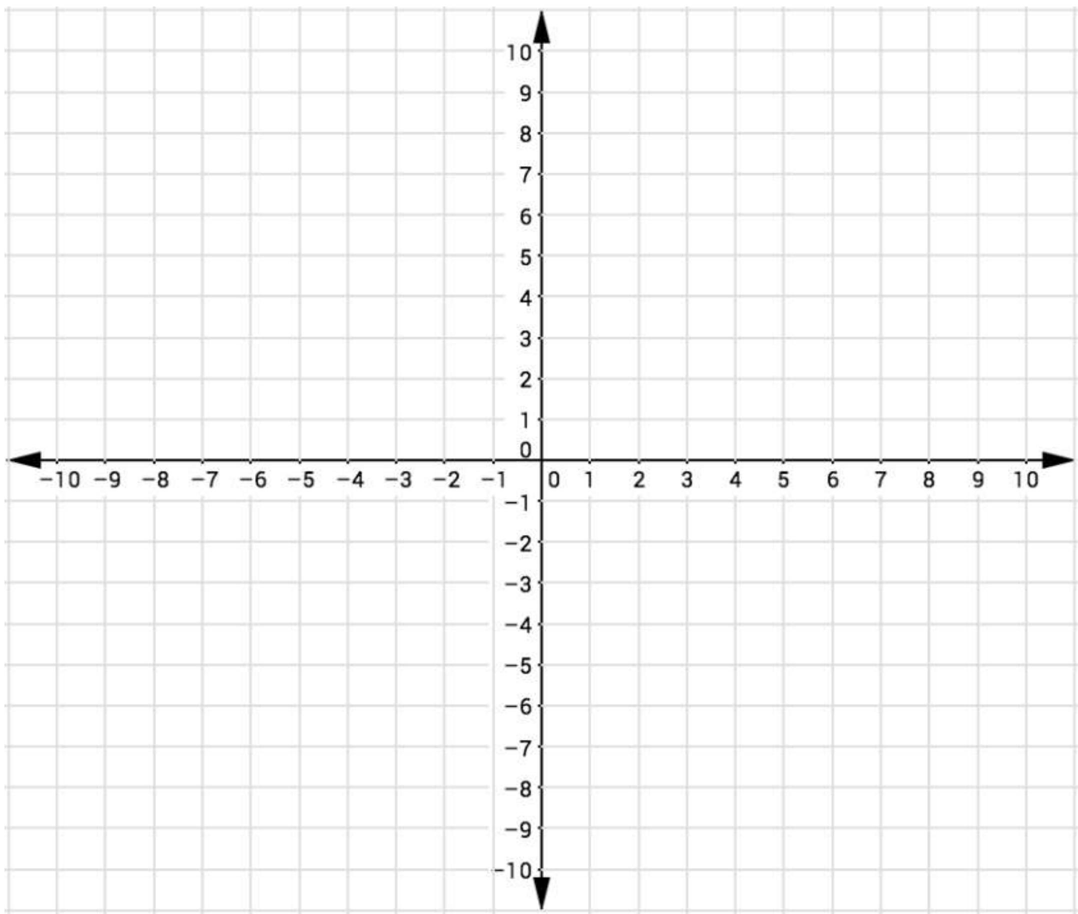
Rotate and draw $COMA$ $90°$ counterclockwise about the origin if the vertices are $C(1, -2), O(0, 2), M(3, 2), A(3, -3)$.



What are the coordinates of $C'O'M'A'$?

Try it!

Samuel rotated $AMEN$ $270°$ clockwise about the origin to generate $A'M'E'N'$ with vertices at $A'(1,5), M'(1,0), E'(-1,-1)$, and $N'(-3,2)$. *You may use the coordinate plane below to draw the rotation.*

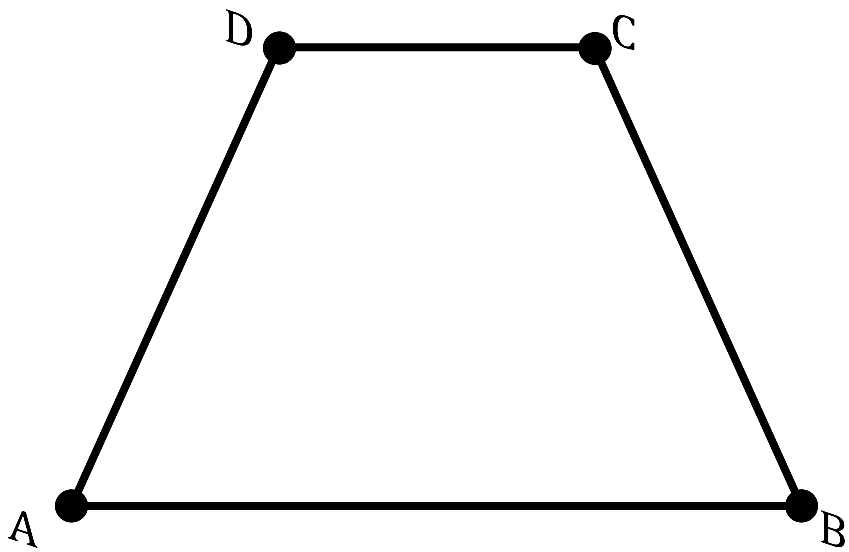


What is the sum of all $y-$ coordinates of $AMEN$?

What happens if we rotate a figure around a different center point instead of rotating it around the origin?

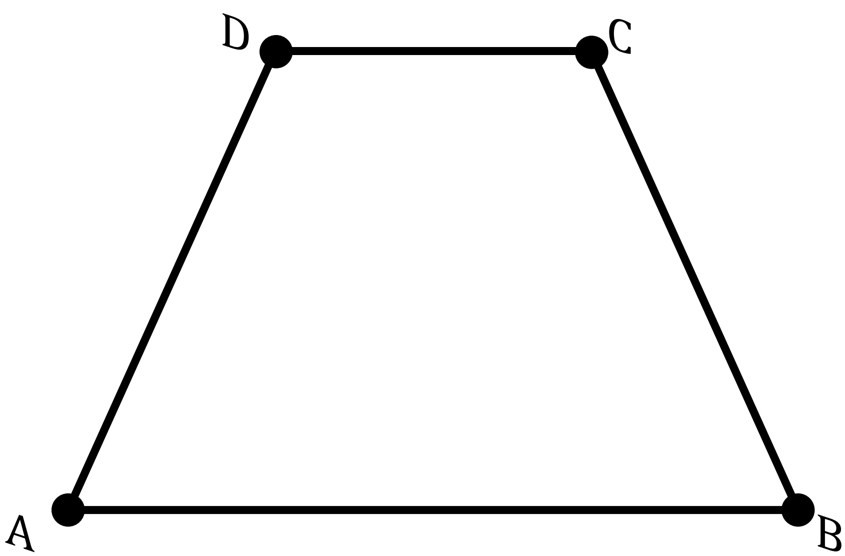
Section 3 – Video 6
Rotation of Polygons – Part 2

Consider the figure below.

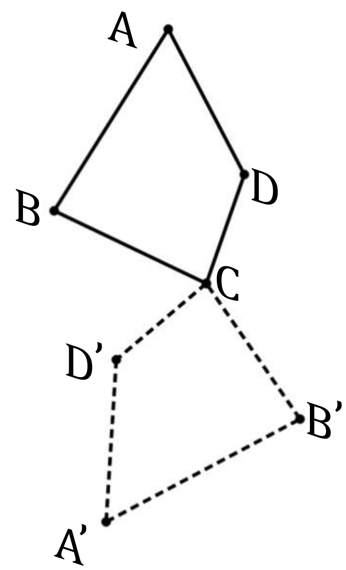


Use the steps below to rotate polygon $ABCD$ $155°$ clockwise about C, using a protractor, compass, and straightedge.

Step 1	Extend the line segment between the point of rotation, C and another vertex on the polygon, D towards the direction of the rotation.
Step 2	Place the center of the protractor on the point of rotation and line it up with the segment drawn in step 1. Measure and draw the angle of rotation at C.
Step 3	Use a compass to measure the segment drawn in step 1, $\overline{CD}$. Construct $\overline{CD'}$.
Step 4	Repeat steps 1-3 for the other two vertices of the polygon.
Step 5	Construct the rotated polygon.


D
C
A
B

Consider the figure below.



Which is the point of rotation? How do you know?

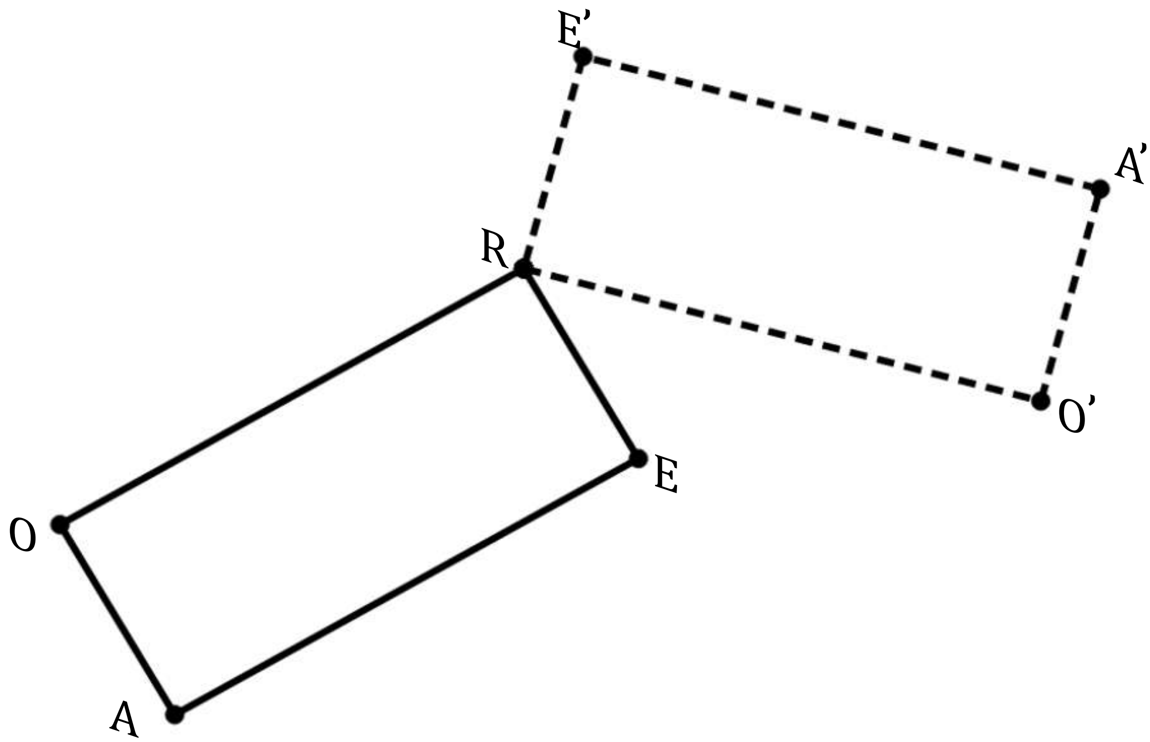
Do you have enough information to determine if the rotation is clockwise or counterclockwise?

If the rotation is clockwise, should it be in between $0° - 90°$, $90° - 180°$, $180° - 270°$, or $270° - 360°$?

If the rotation is counterclockwise, should it be in between $0° - 90°$, $90° - 180°$, $180° - 270°$, or $270° - 360°$?

Let's Practice!

Consider the figure below.

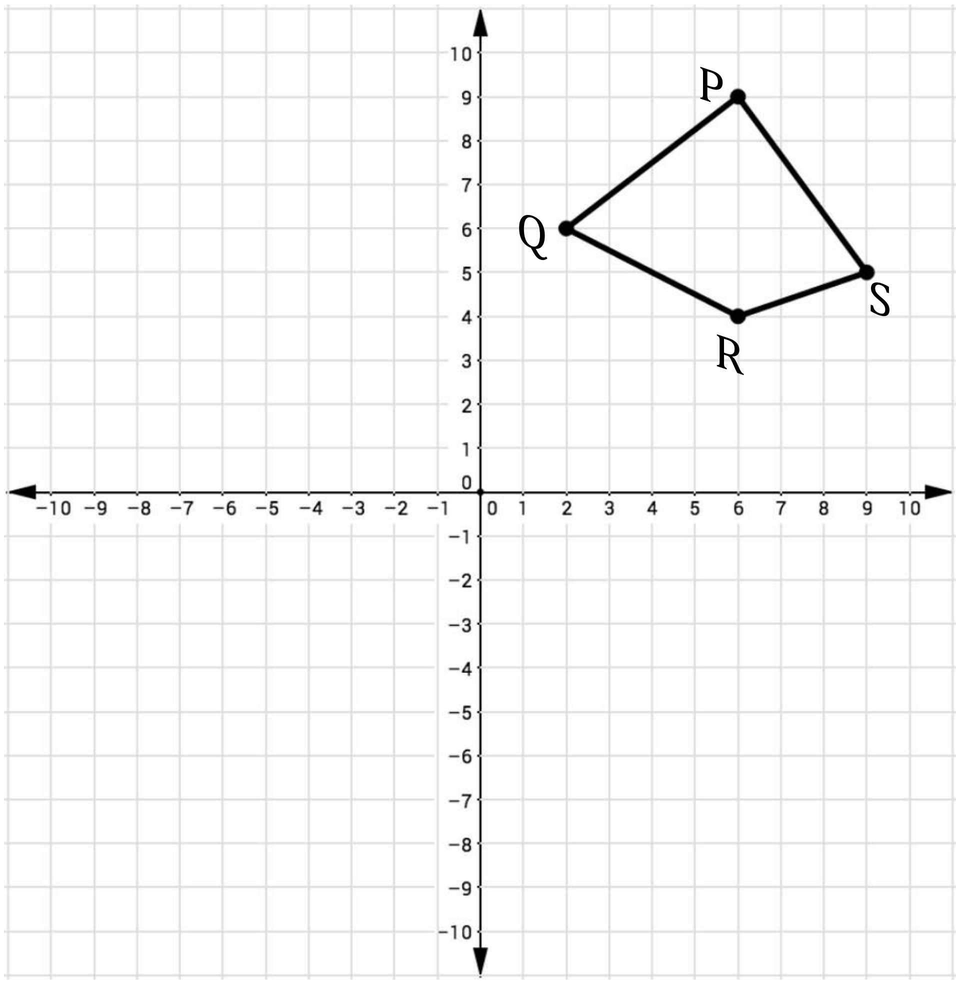


Which of the following statements is true?

- o The figure shows quadrilateral $AERO$ rotated $45°$ counterclockwise about R and $90°$ clockwise about R.
- o The figure shows quadrilateral $AERO$ rotated $45°$ clockwise about R and $90°$ counterclockwise about R.
- o The figure shows quadrilateral $AERO$ rotated $135°$ clockwise about R and $225°$ counterclockwise about R.
- o The figure shows quadrilateral $AERO$ rotated $135°$ counterclockwise about R and $225°$ clockwise about R.

Try it!

Consider quadrilateral $PQRS$ on the coordinate plane below.



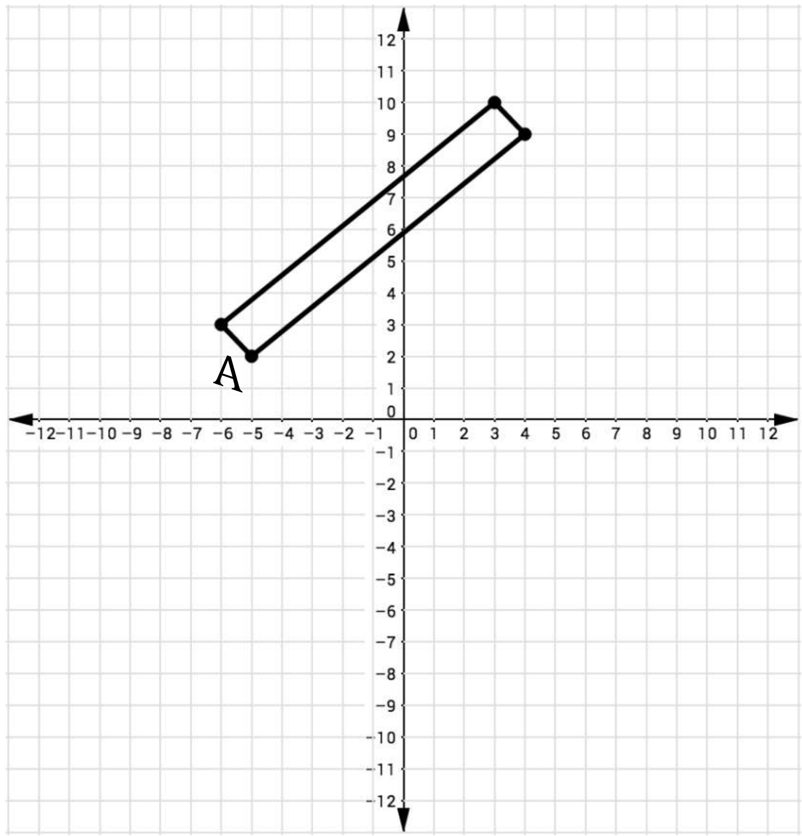
After a rotation of $PQRS$ $90°$ clockwise about point $(6, 3)$, answer each of the following questions.

Part A: Which vertex will be at point $(9, 7)$?

Part B: What will be the coordinates of point R'?

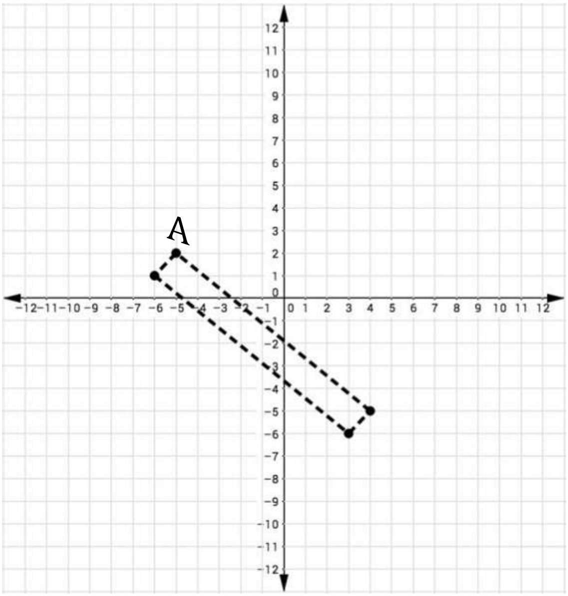
BEAT THE TEST!

1. Consider the quadrilateral below, in which A is the point for rotation.

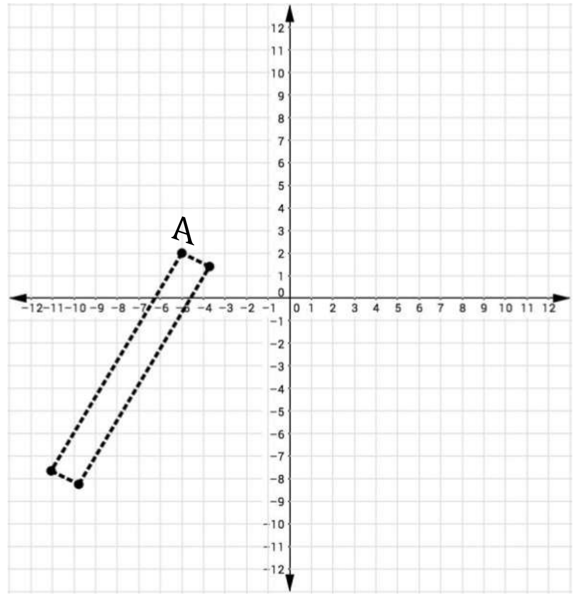


Which figure on the following page shows the quadrilateral rotated $80°$ clockwise about A?

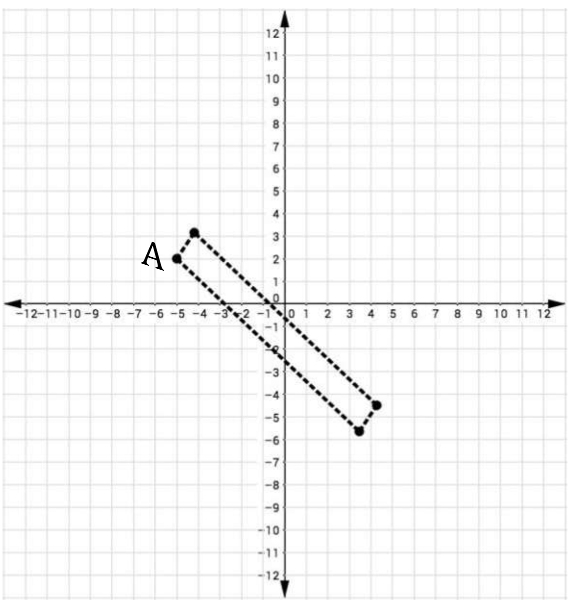
○


A

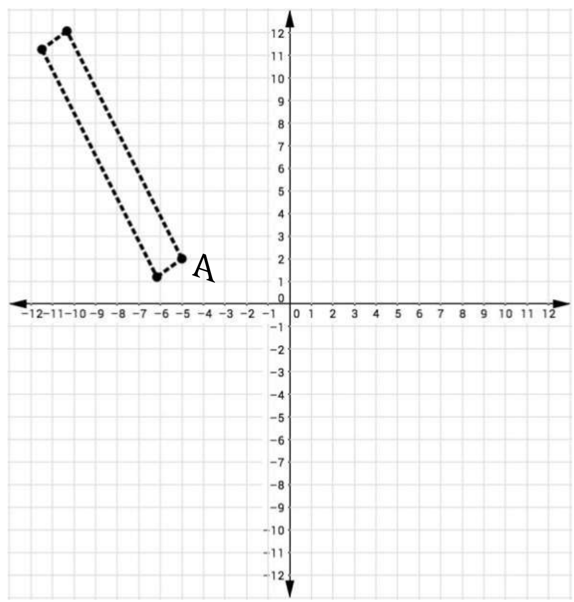
○


A

○


A

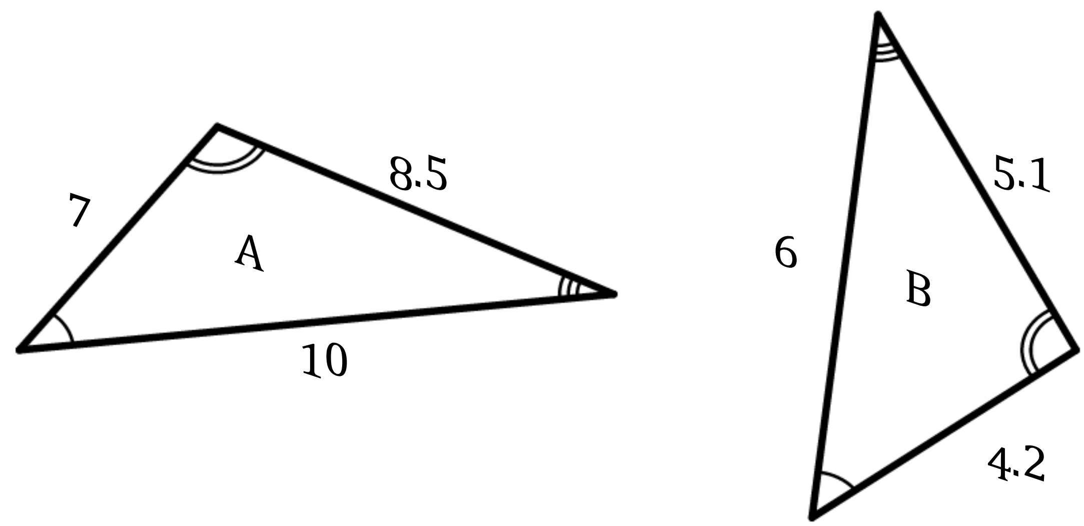
○


A

Section 3 – Video 7
Dilation of Polygons – Part 1

How is a ***dilation*** different from a translation, reflection, and rotation?

Consider the figures below.



Is Figure B a dilation of Figure A? Justify your answer.

What is the scale factor?

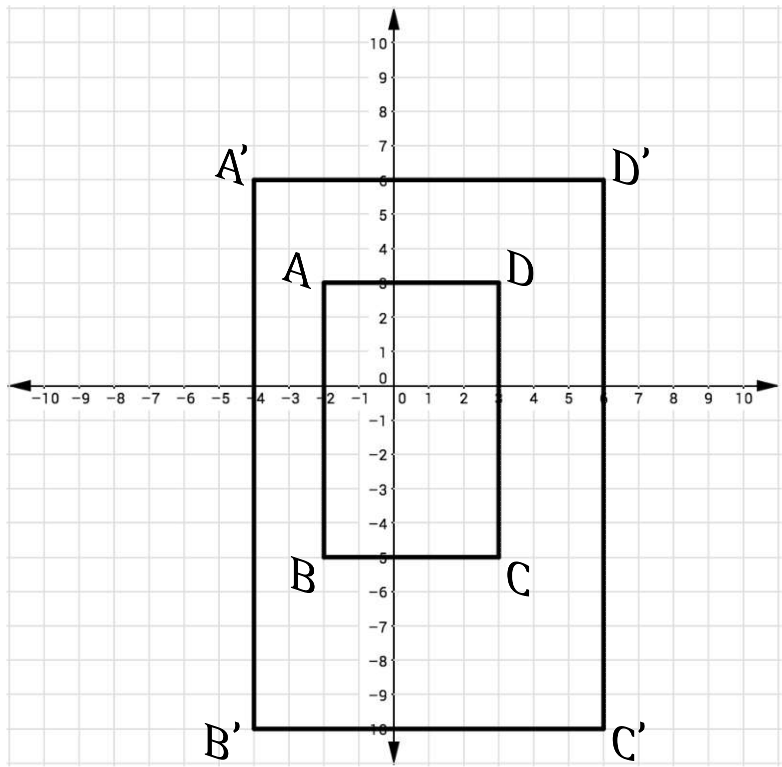
Is Figure A a dilation of Figure B? Justify your answer.

What is the scale factor?

We often represent a dilation with the following notation:

$$D_k = k(x, y)$$

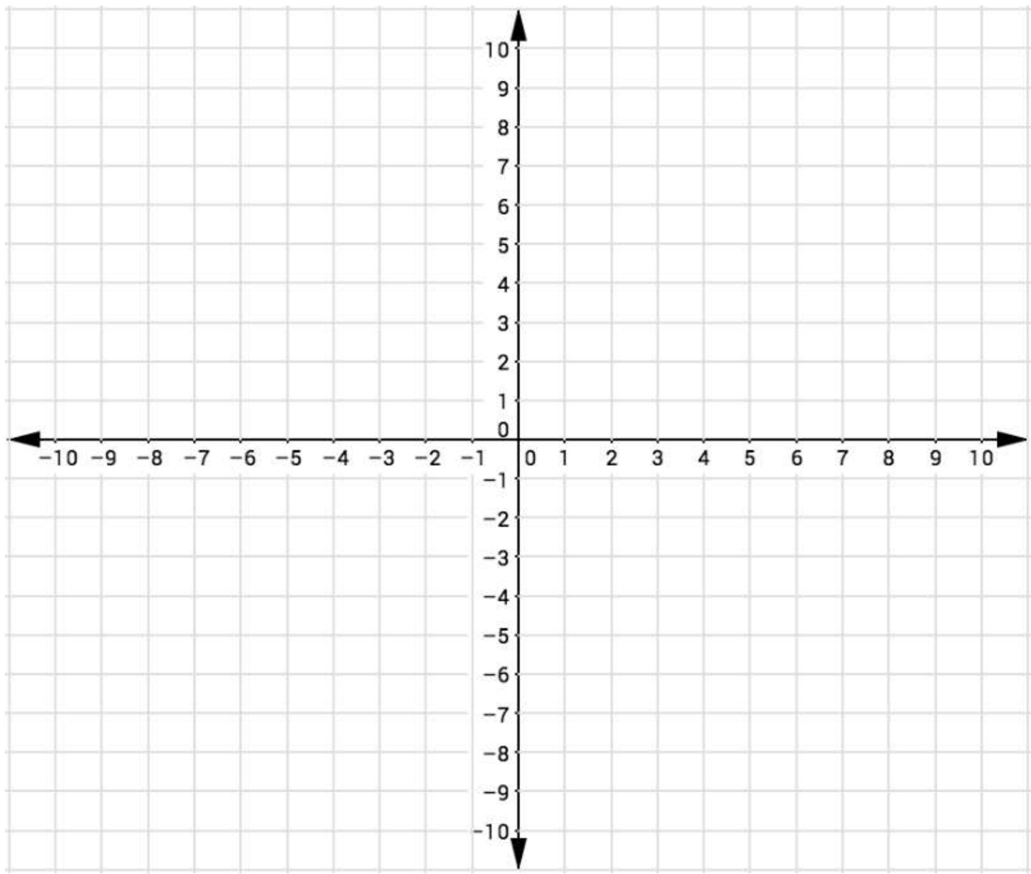
Consider the dilation of quadrilateral $ABCD$ below.



What do you notice about the dilation represented in the figure above?

Let's Practice!

Pentagon $PENTA$ has coordinates $P(0,0), E(4,4), N(8,4)$, $T(8,-4)$, and $A(4,-4)$ and is dilated at the origin with a scale factor of $\frac{3}{4}$.



What are the coordinates of $P'E'N'T'A'$?

Try it!

Quadrilateral $PINT$ is dilated at the origin with a scale factor of $\frac{5}{3}$.

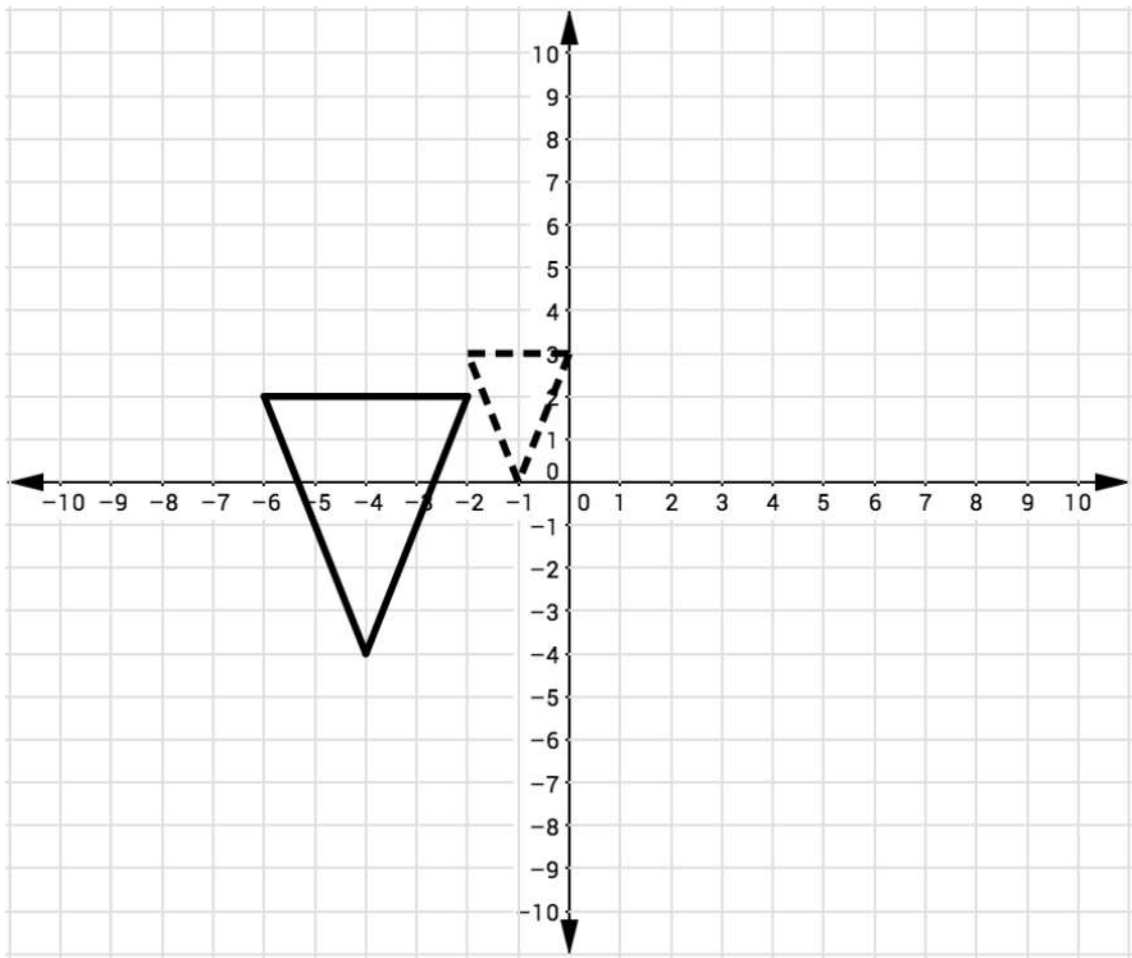
Describe Quadrilateral $PINT$ and Quadrilateral $P'I'N'T'$ by filling in the table below with the most appropriate answer.

Quadrilateral $PINT$	Quadrilateral $P'I'N'T'$
(x, y)	$(\quad , \quad)$
$P(3,3)$	$P'(\quad , \quad)$
$I(\quad , \quad)$	$I'(10,15)$
$N(\quad , \quad)$	$N'(15,-5)$
$T(-3,-6)$	$T'(\quad , \quad)$

Section 3 – Video 8
Dilation of Polygons – Part 2

What happens when the center of dilation is not the origin?

Consider the figures below.



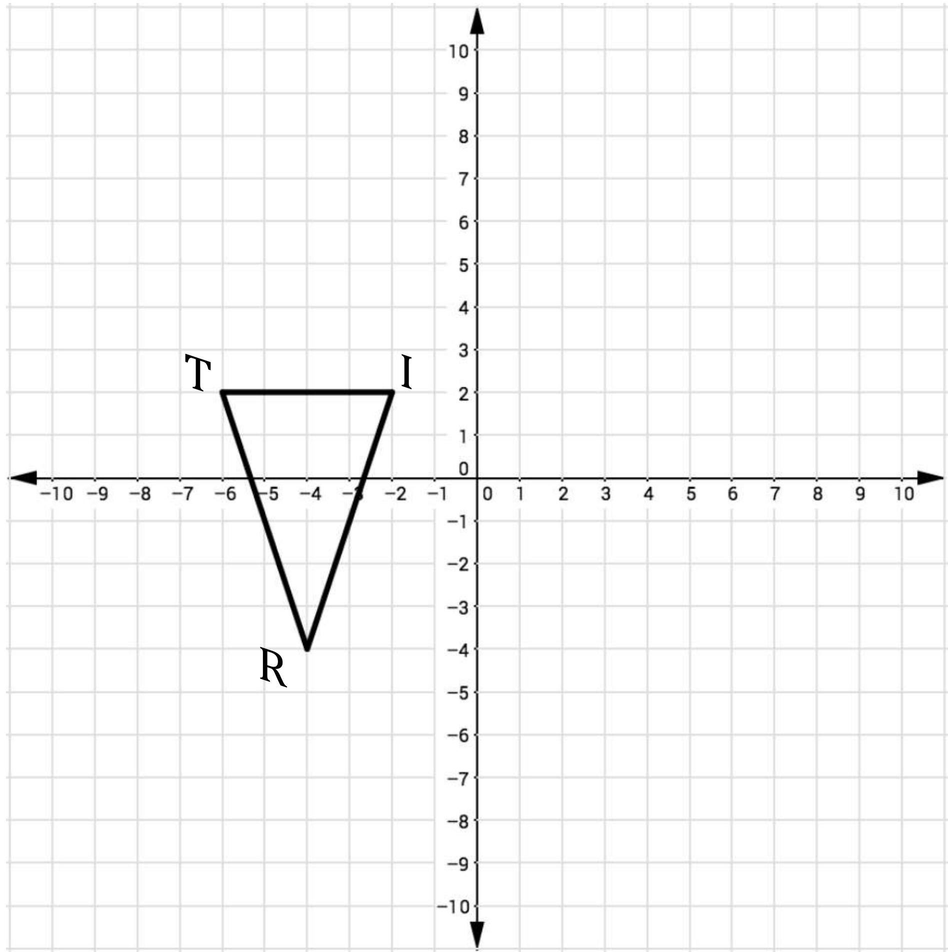
In which quadrant do you think the center of dilation lies? Justify your answer.

Let's Practice!

Consider the following steps for dilating a polygon that is not centered at the origin.

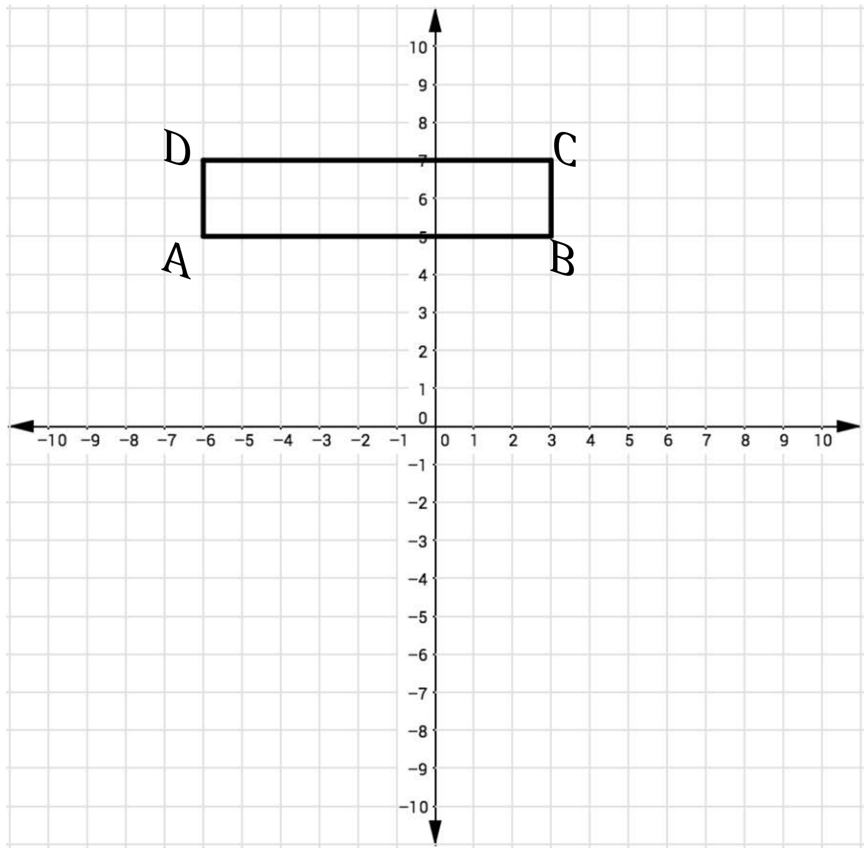
Dilate triangle TRI on the following page by a scale factor of $\frac{1}{2}$ using the center of dilation of $(2,6)$.

Step 1	Draw the center of dilation, $(2, 6)$.
Step 2	Count the horizontal and vertical change from the center of dilation to point T on the pre-image.
Step 3	Multiply the horizontal and vertical change found in step 2 by the scale factor. Use this new horizontal and vertical change to graph T' from the center of dilation: $(2,6)$
Step 4	Complete steps 2 and 3 for points R and I.
Step 5	Construct triangle $T'R'I'$.


T
I
R

Try it!

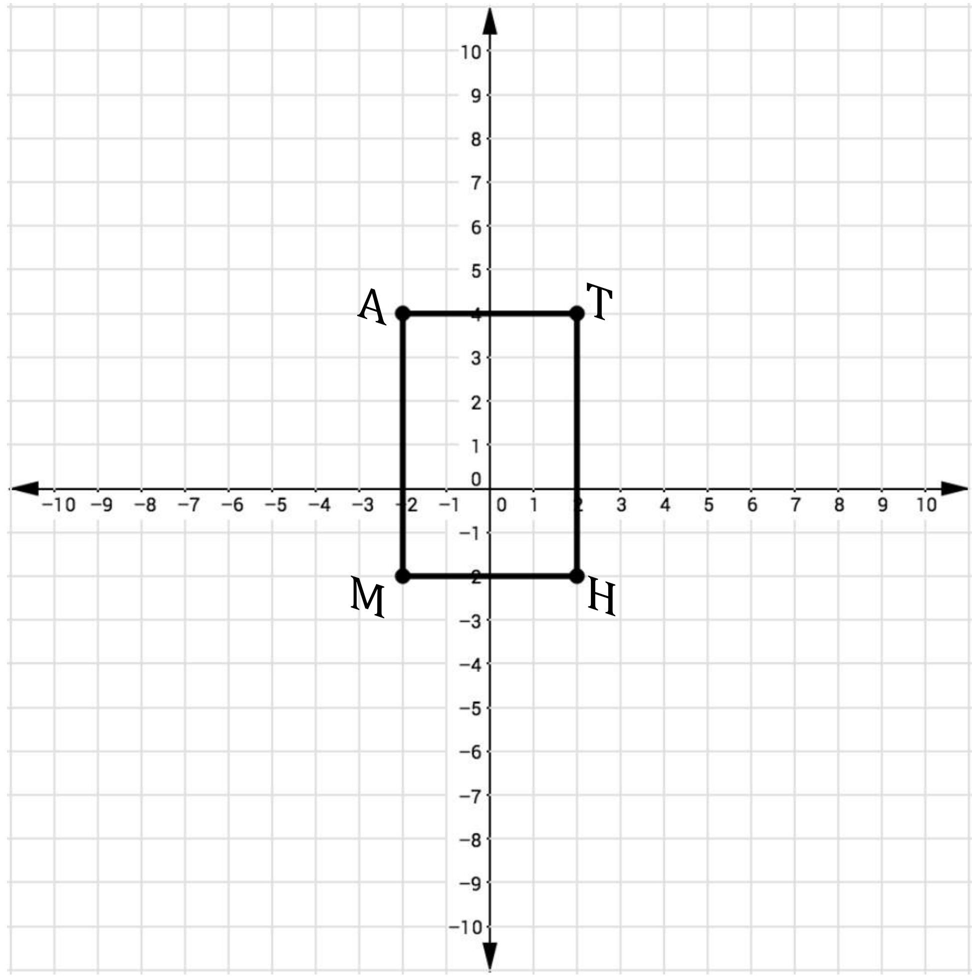
Consider rectangle $ABCD$.



Dilate $ABCD$ by a scale factor of $\frac{1}{2}$ using a center of dilation of $(1, 1)$. Draw $A'B'C'D'$ on the same coordinate plane.

BEAT THE TEST!

1. Consider Quadrilateral $MATH$ on the figure below.



Quadrilateral $MATH$ is dilated by a scale factor of 0.5 centered at $(-2, -2)$ to create quadrilateral $M'A'T'H'$.

What is the difference between the y - coordinate of A' and the y - coordinate of T'?

The difference is ☐ units.

2. Triangle PRA has coordinates $P(-2,-4), R(-6,-2), A(-2,-2)$. Write the coordinates of the vertices after a dilation with a scale factor of 3.5, centered at $(1,1)$.

$$P(-2,-4) \rightarrow P'(\_\_\_\_,\_\_\_\_)$$

$$R(-6,-2) \rightarrow R'(\_\_\_\_,\_\_\_\_)$$

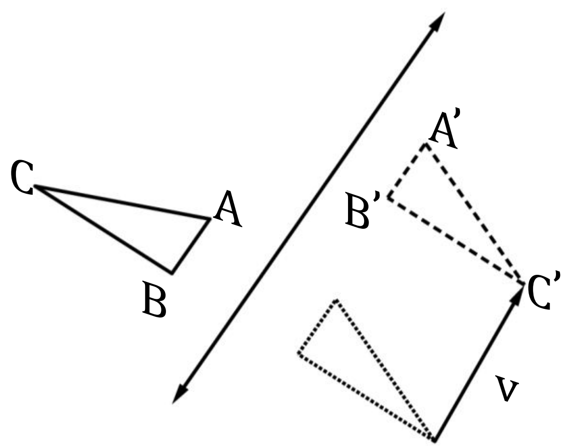
$$A(-2,-2) \rightarrow A'(\_\_\_\_,\_\_\_\_)$$

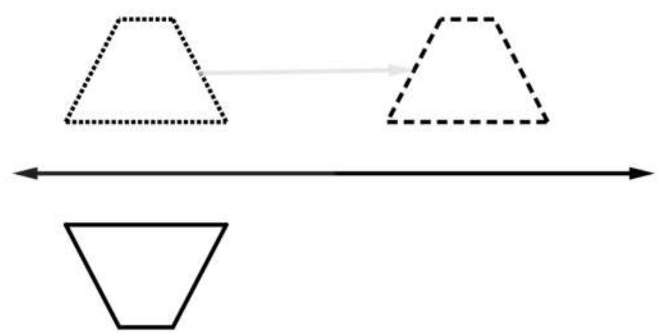
Section 3 – Video 9
Compositions of Transformations of Polygons

What do you think ***composition of transformations*** means?

Identify and describe a real-life example.

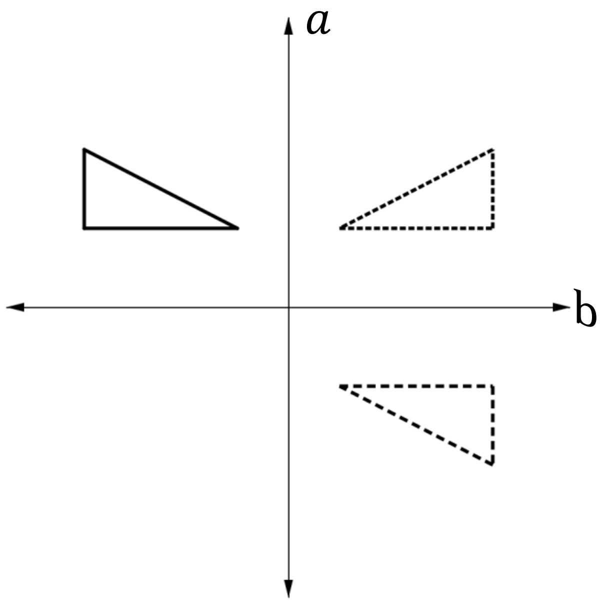
Consider the following ***glide reflections***.

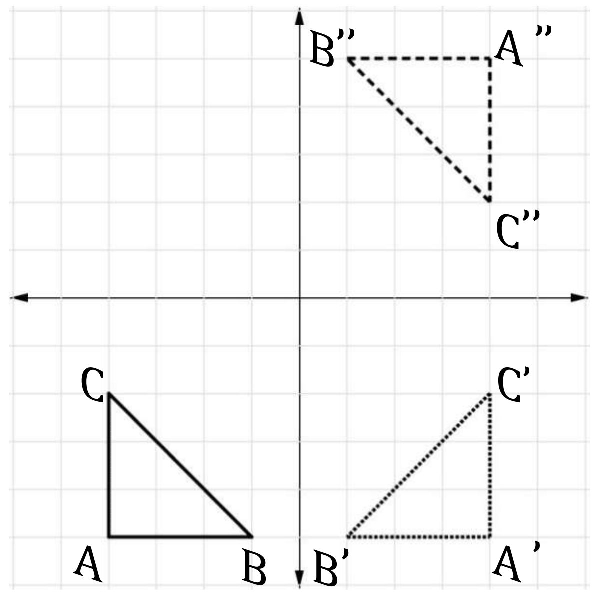




What do you notice about the glide reflections?

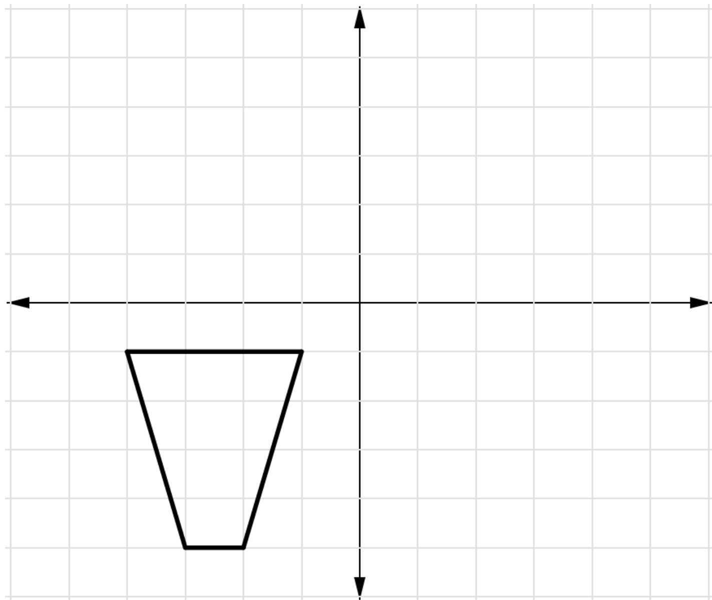
Consider the following ***double reflections***.



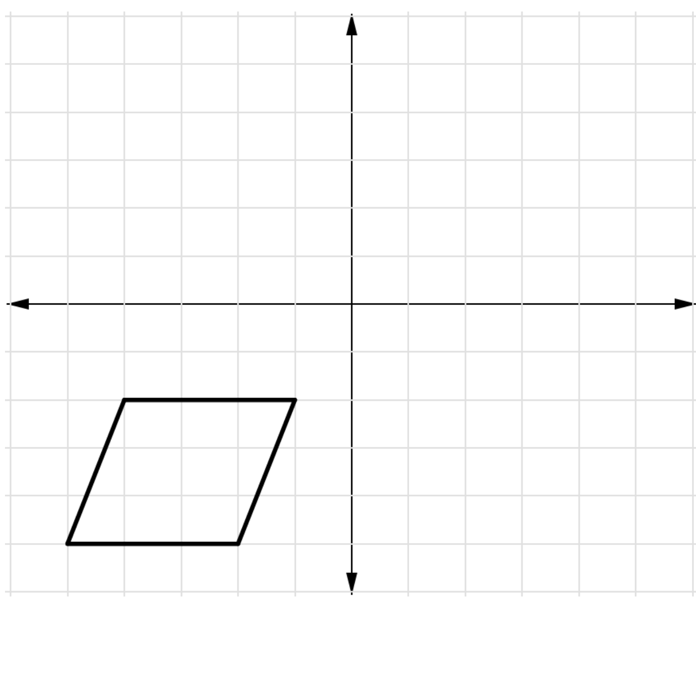


What do you notice about the double reflections?

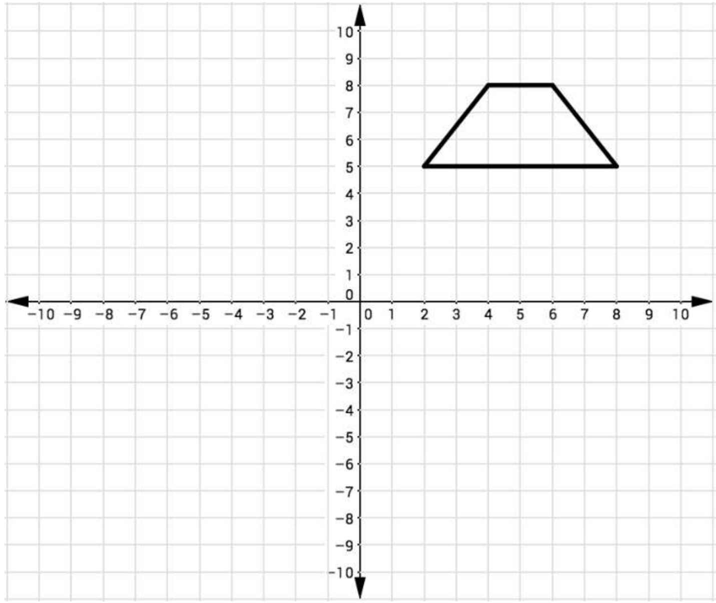
Consider the following figure that represents a ***composition of isometries*** below. Reflect the figure over $x = 1$, then rotate the figure $270°$ clockwise about the origin.



Consider the following figure to represent other compositions below. Dilate the figure at the origin with a scale factor of $\frac{1}{2}$ and then reflect the figure over $y = -x$.



Consider the figure below.



If you are limited by three transformations, describe what type(s) of transformations or compositions will carry the polygon below to itself.

Let's Practice!

If we have the pre-image $S(7,2), P(0,9), O(-6,-5), T(1,-12)$ and we reflect it over the $x-$ axis then rotate it $90°$ counterclockwise about the origin, what are the coordinates of $S"P"O"T"$? Write each answer in the space provided below.

$S(7,2) \rightarrow S'($ ____ , ____ $) \rightarrow S"($ ____ , ____ $)$

$P(0,9) \rightarrow P'($ ____ , ____ $) \rightarrow P"($ ____ , ____ $)$

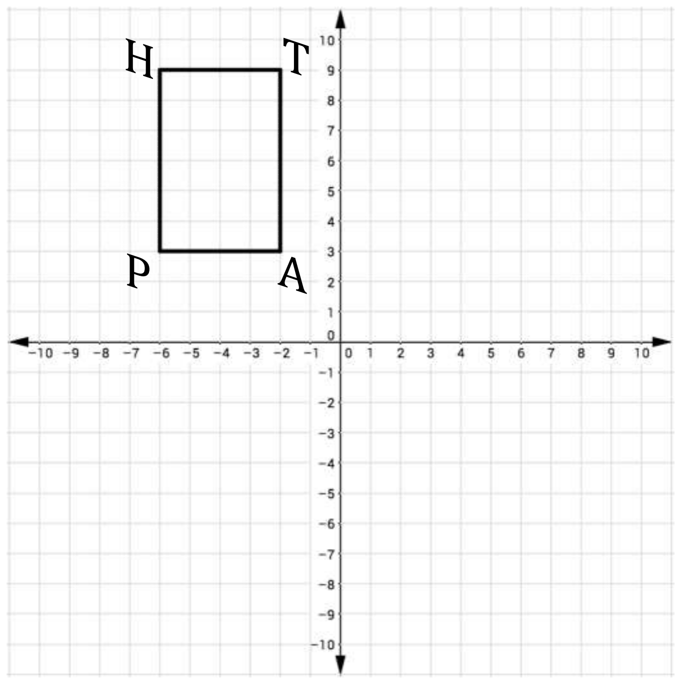
$O(-6,-5) \rightarrow O'($ ____ , ____ $) \rightarrow O"($ ____ , ____ $)$

$T(1,-12) \rightarrow T'($ ____ , ____ $) \rightarrow T"($ ____ , ____ $)$

If you take $S"P"O"T"$ and dilate it by a scale factor of 3, what are the coordinates of $S'''P'''O'''T'''$? Justify your answer.

Try it!

Consider the figure below and the following rotation. Rectangle $PATH$ is rotated $270°$ counterclockwise around the origin and then reflected across the $y-axis$.



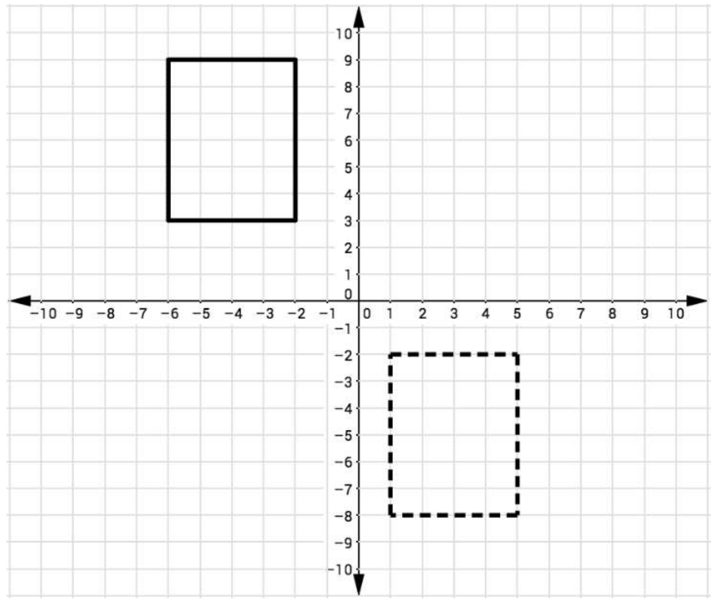
Tatum argues that the image created above will be the same as the pre-image. Marla refutes the answer by arguing that the images will not be the same. Who is correct? Justify your answer.

BEAT THE TEST!

1. Point $L''(-9,0)$ is a vertex of triangle $L''I''E''$. The original image was rotated $90°$ clockwise and then translated $(x, y) \to (x - 8, y + 5)$. What are the coordinates of the original image's point L before the composition of transformations?

A $(-1, -5)$
B $(0, -4)$
C $(1, -5)$
D $(5, -1)$

2. Consider the following polygon after a composition of transformations represented by the dashed lines below.

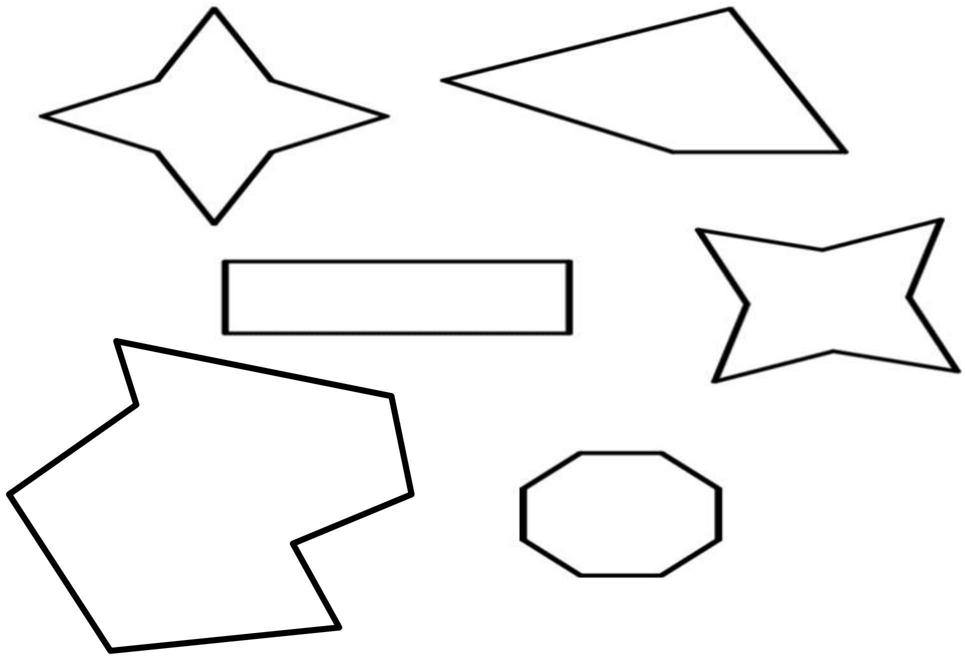


Which composition of isometries did the polygon have?

- o A reflection over the $x - axis$ and a translation $(x + 7, y + 1)$.
- o A reflection over the $y = 1$ and a translation $(x + 7, y)$.
- o A translation $(x + 8, y - 3)$ and a rotation of $90°$ clockwise about $(1,1)$.
- o A translation $(x + 10, y)$ and a reflection over $y = -x$.

Section 3 – Video 9
Symmetries of Regular Polygons

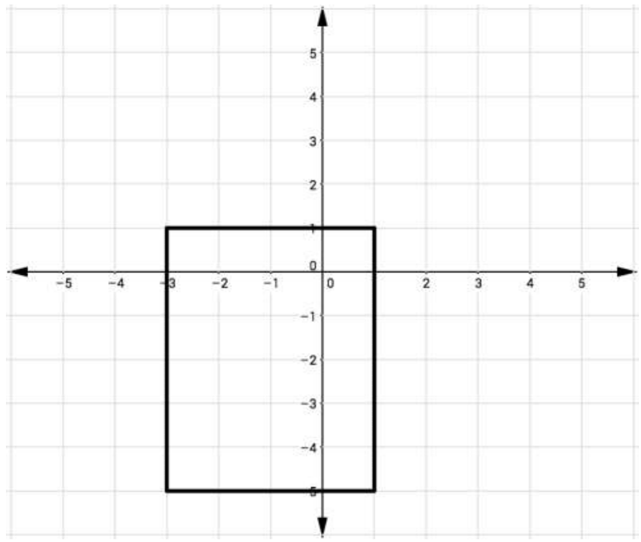
Which of the following are symmetrical? Circle each figure that is symmetrical.



What do you think it means to map a figure onto itself?

Draw a figure and give an example of a single transformation that carries the transformation onto itself.

Consider the rectangle shown below in the coordinate plane. We need to identify the equation of the line that maps the figure onto itself after a reflection across that line.



Reflect the image across the line $x = -1$. *Does the transformation result in the original pre-image?*

Reflect the image across the line $y = -1$. *Does the transformation result in the original pre-image?*

Reflect the image across the line $y = x - 1$. *Does the transformation result in the original pre-image?*

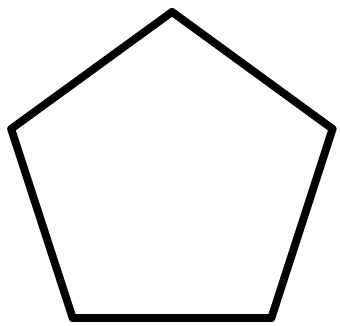
Reflect the image across the line $y = -2$. *Does the transformation result in the original pre-image?*

The equations of the lines that map the rectangle above onto itself are _____________________ and _______________________.

Reflecting a regular $n - gon$ across a line of symmetry carries the $n - gon$ onto itself.

Let's explore lines of symmetry.

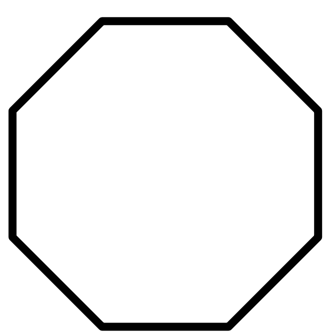
In regular polygons, if n is odd, the lines of symmetry will pass through a vertex and the midpoint of the opposite side. Draw the lines of symmetry on the polygon below.



In regular polygons, if n is even, there are two scenarios.

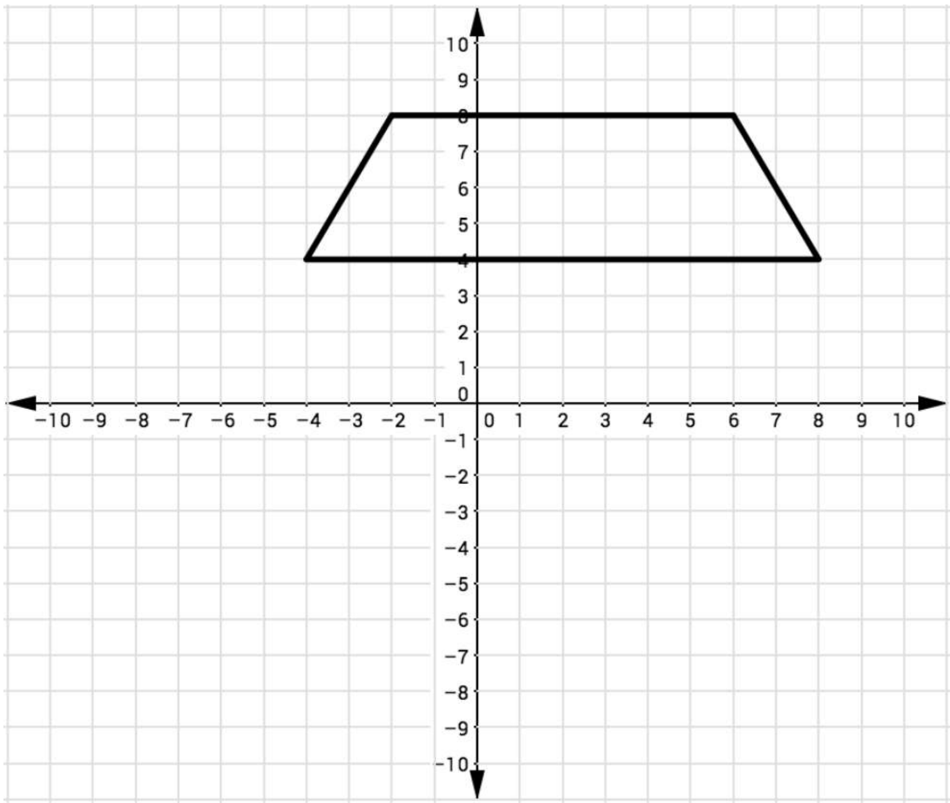
- The lines of symmetry will pass through two opposite vertices.
- The lines of symmetry will pass through the midpoints of two opposite sides.

Draw the lines of symmetry on the polygon below.



Let's Practice!

Consider the trapezoid below.

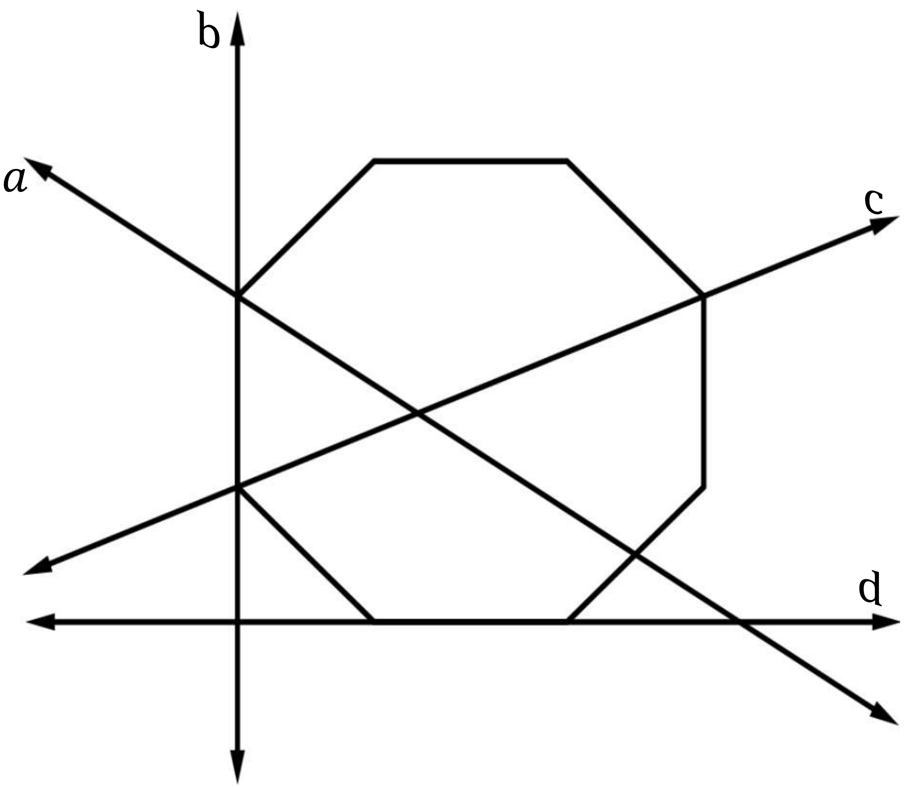


Which line will carry the figure onto itself?

- ○ $x = 2$
- ○ $x = 1$
- ○ $y = 6$
- ○ $y = 2x + 12$

Try it!

Which of the following transformations carries this regular polygon onto itself?



- o Reflection across line a
- o Reflection across line b
- o Reflection across line c
- o Reflection across line d

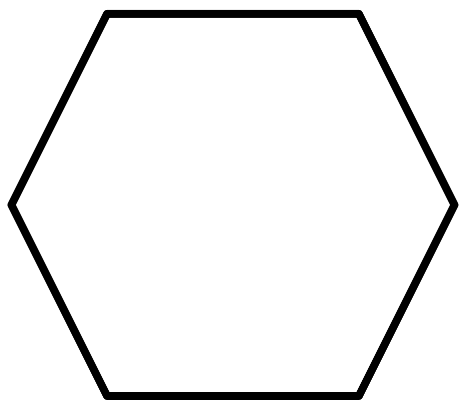
How many ways can you reflect a regular octagon onto itself?

Rotations also carry a geometric figure onto itself.

What rotations will carry a regular polygon onto itself?

About which point do you rotate a figure in order to carry it onto itself?

What rotation would carry this regular hexagon onto itself?

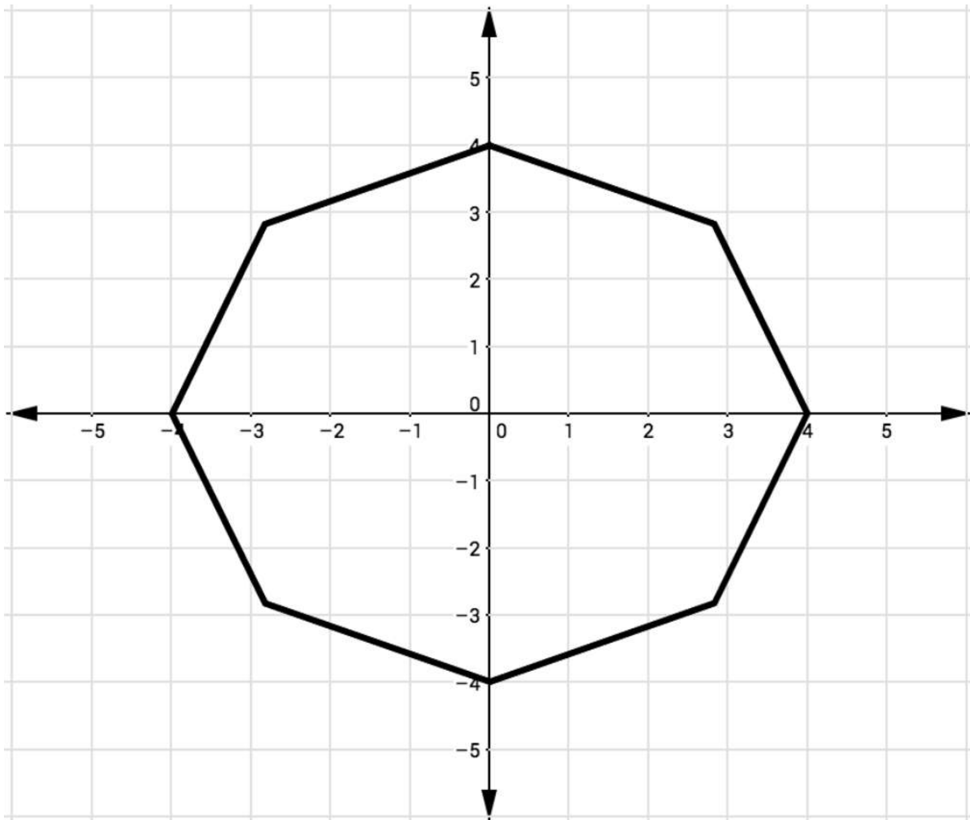


STUDY EDGE TIP

Rotating a regular $n - gon$ by a multiple of $\frac{360°}{n}$ carries the $n - gon$ onto itself.

Let's Practice!

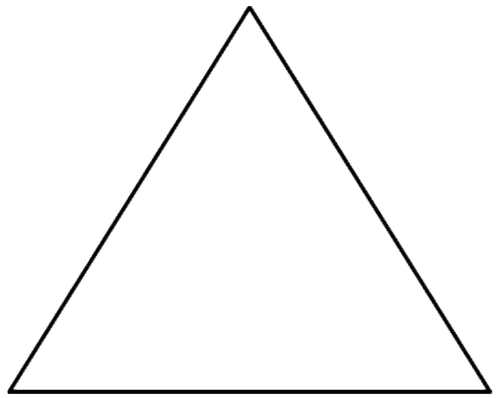
Consider the regular octagon below.



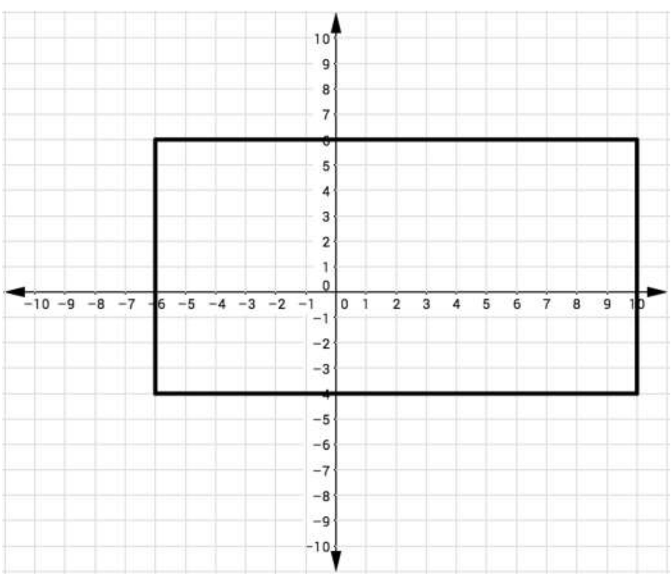
Describe a rotation that will map this regular octagon with center at the origin and a vertex at $(4, 0)$ onto itself.

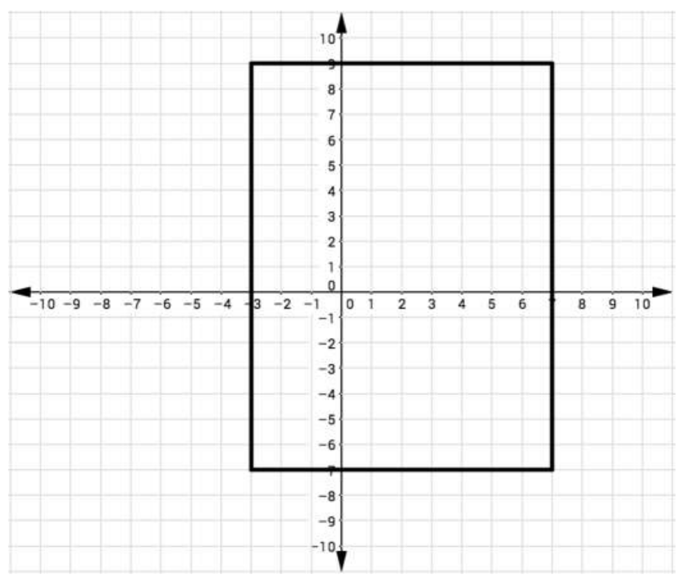
Try it!

Which rotations will carry this regular polygon onto itself?



Consider the two rectangles below.

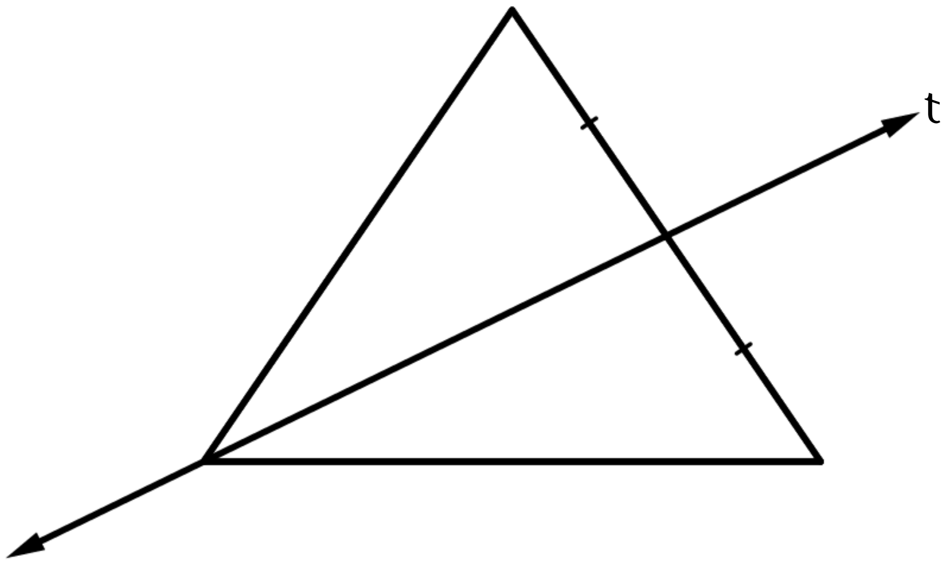




The degree of rotation that maps each figure onto itself is a rotation _______ degrees about the point (______ , ______).

BEAT THE TEST!

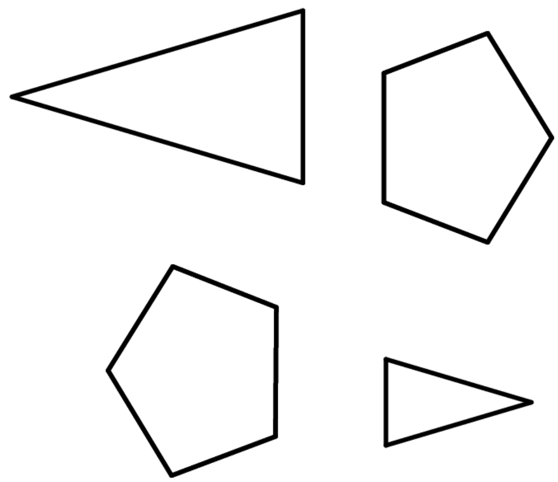
1. Which of the following transformations carry this regular polygon onto itself? Select all that apply.



- ☐ Reflection across line t
- ☐ Reflection across its base
- ☐ Rotation of 40° counterclockwise
- ☐ Rotation of 90° counterclockwise
- ☐ Rotation of 120° clockwise
- ☐ Rotation of 240° counterclockwise

Section 3 – Video 10
Congruence and Similarity of Polygons

Consider the figures below.



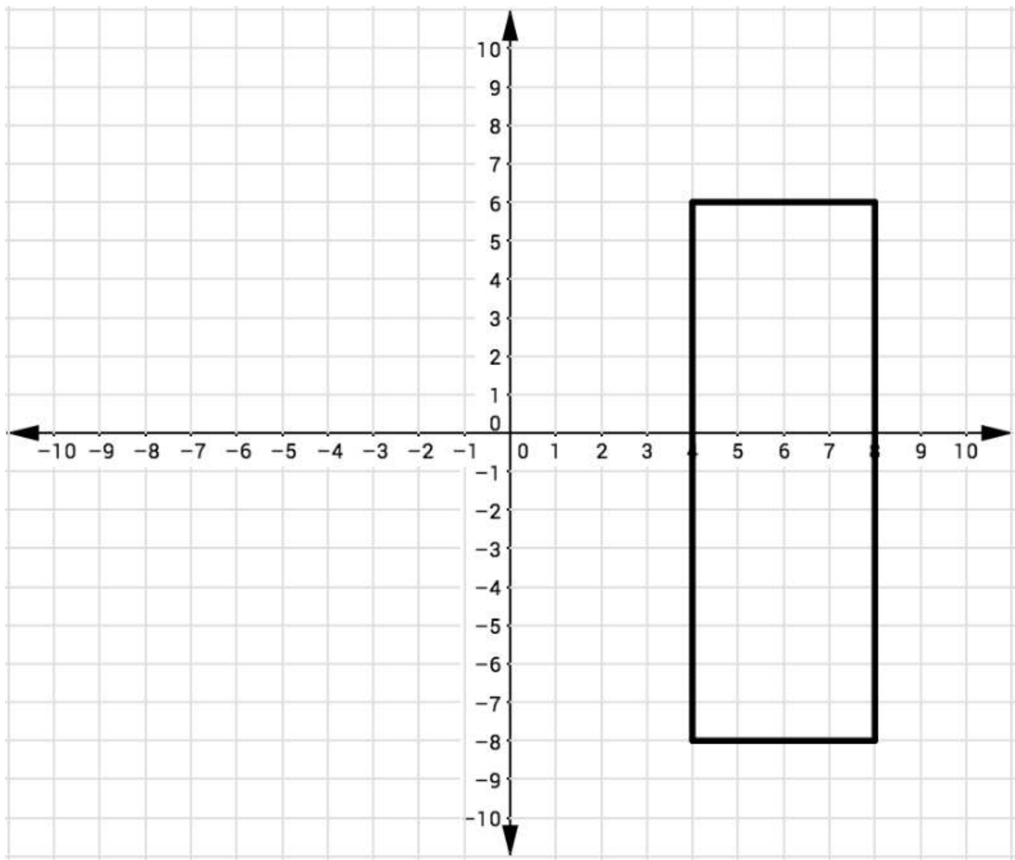
Which of the figures are congruent? How do you know?

Use observations from the figures above to state properties of congruent polygons.

- Congruent polygons have the same number of _________ and ___________.
- Corresponding ________ of congruent polygons are congruent.
- Corresponding interior _________ of congruent polygons are congruent.

Let's Practice!

Which coordinates will produce a rectangle that is congruent to the one shown below?



- $(-2, -4), (0, -4), (-2, 14), (0, 14)$
- $(-6, -4), (-2, -4), (-6, 10), (-2, 10)$
- $(-6, -8), (0, -8), (-6, 4), (0, 4)$
- $(0, 0), (4, 0), (0, 10), (10, 4)$

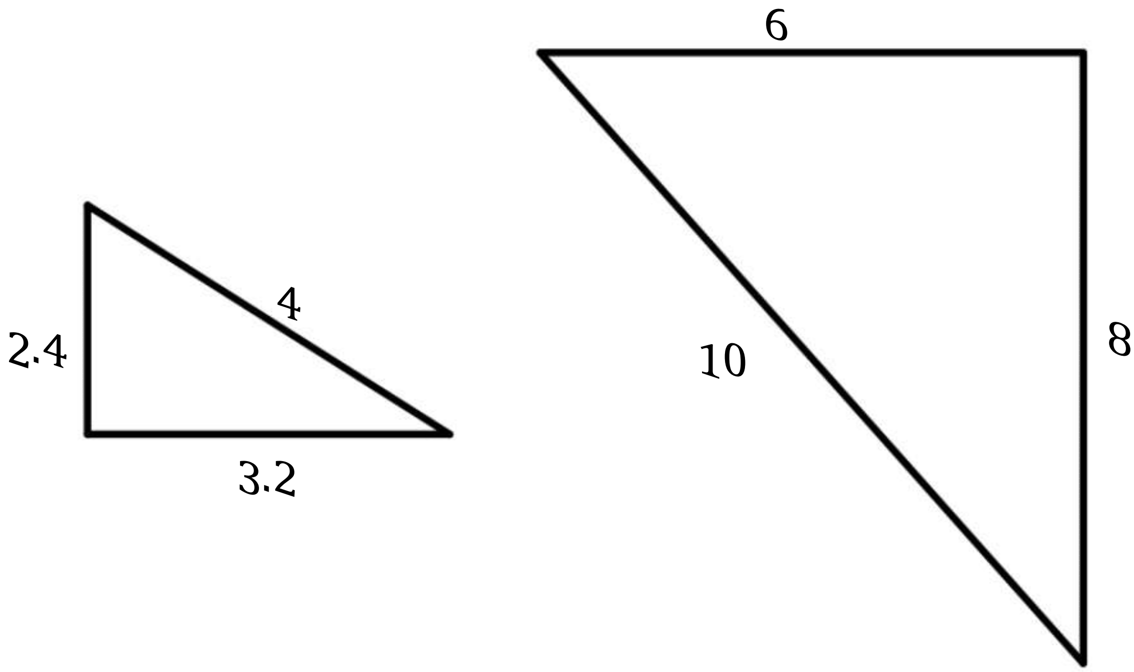
Try it!

Three of the angle measures of a quadrilateral that Romeo drew are $72°, 136°$, and $110°$. Juliet drew a quadrilateral that is congruent to Romeo's. Which of the following is one of the angle measures of Juliet's quadrilateral?

- $42°$
- $52°$
- $70°$
- $108°$

Similar Figures

The following shapes are similar but not congruent.

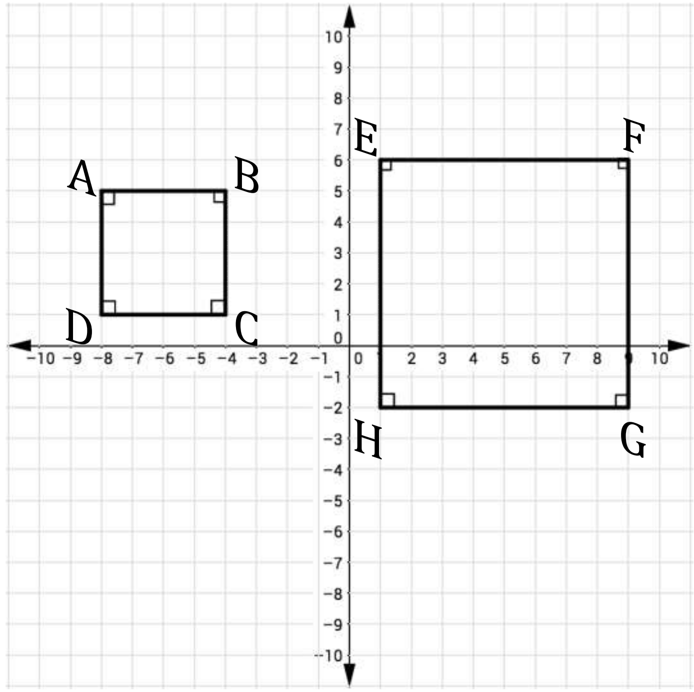


Why do you think that we can classify these shapes as "similar" figures?

Use observations from the figures above to state properties of similar polygons.

- Similar polygons have the same number of _________ and _________.
- Corresponding interior __________ of similar polygons are congruent.
- Corresponding __________ of similar polygons are proportional.

Consider the polygons on the coordinate plane below.

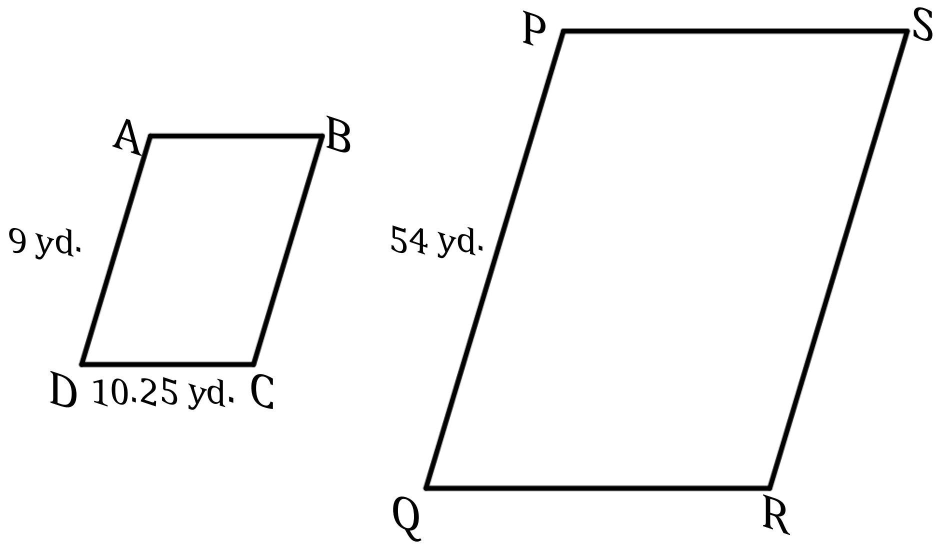


Based on the two similar squares above, name the properties of similar polygons. Give the justifications that prove the figures are similar.

Properties	Justifications
1.	
2.	
3.	
4.	

Let's Practice!

Parallelograms $ABCD$ and $PQRS$ are similar.



What is the length of $\overline{PS}$?

Mrs. Kemp's rectangular garden has a length of 20 meters and a width of 15 meters. Her neighbor, Mr. Pippen, has a garden similar in shape with a scale factor of 3.

What is the width of Mr. Pippen's garden?

How do the areas of the gardens relate to one another?

STUDY EDGE TIP

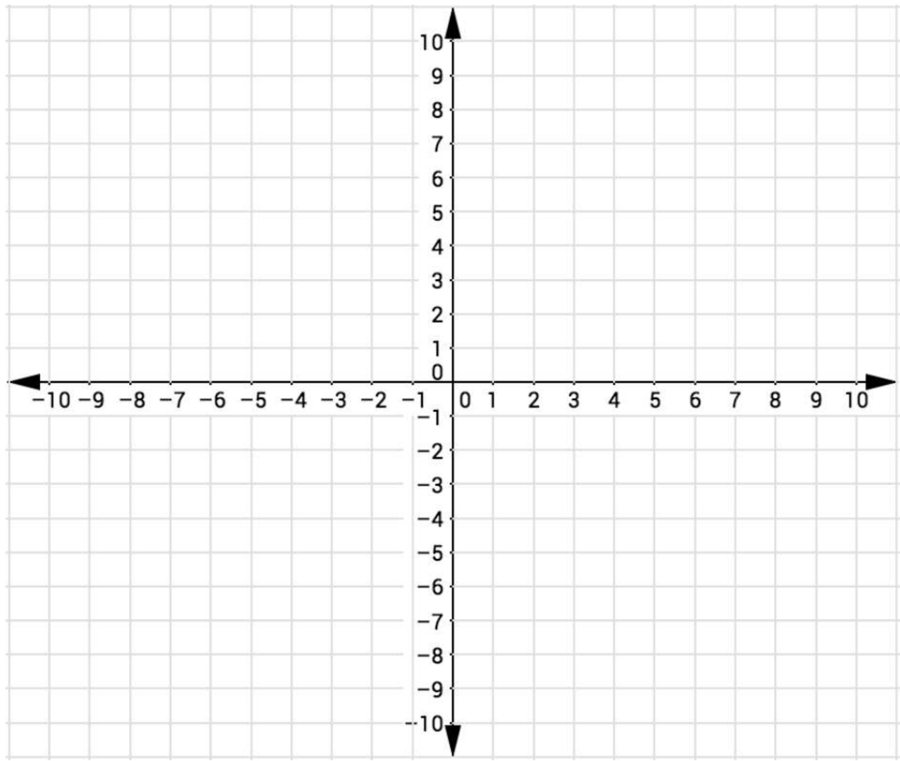
Each corresponding side of one polygon can be multiplied by the ***scale factor*** to the get the length of its corresponding side on a similar polygon.

Try it!

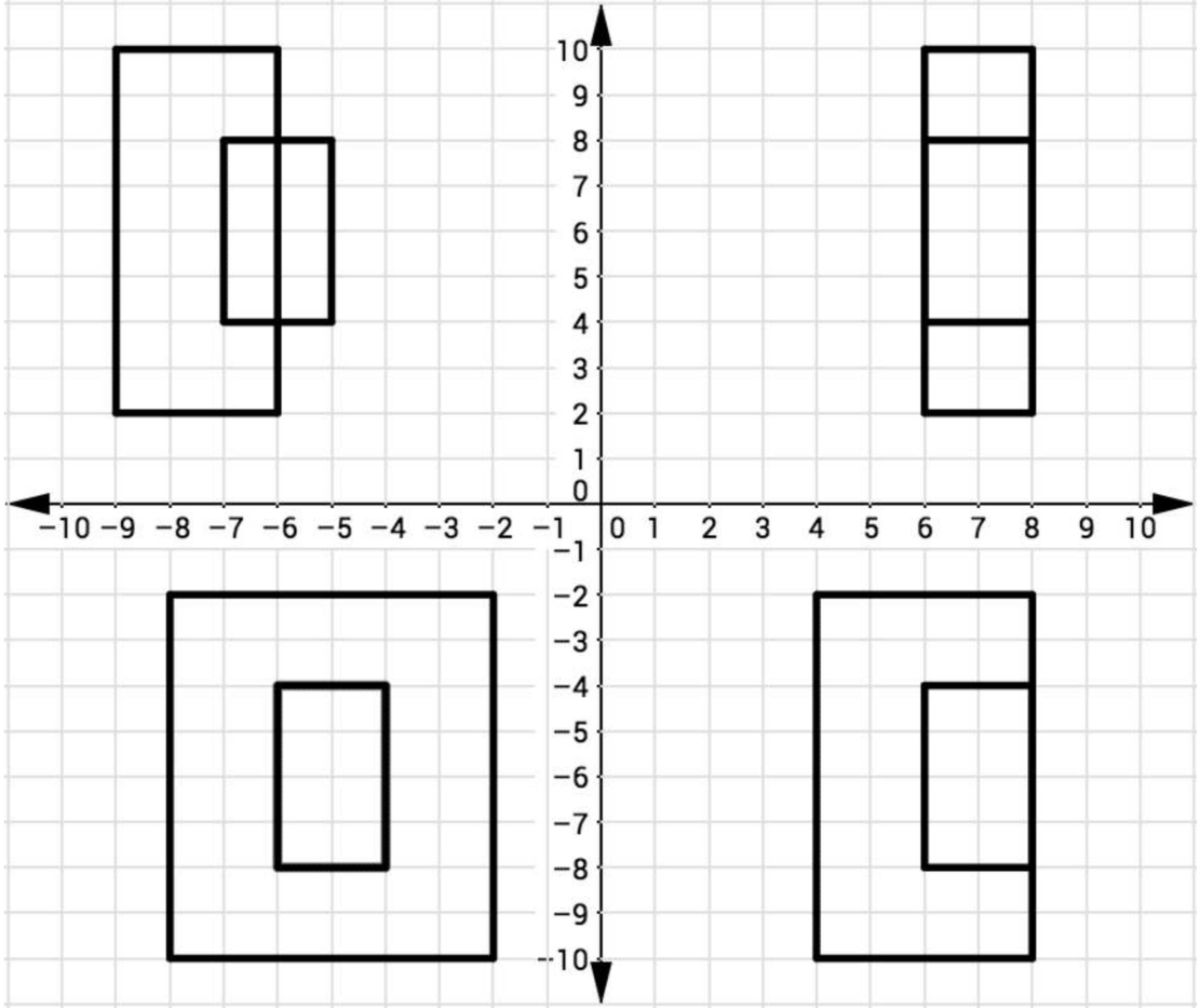
A right triangle has a base of 11 yards and a height of 7 yards. If you were to construct a similar but not congruent right triangle with area of 616 square yards, what would the dimensions of the new triangle be?

Triangle TOY is similar to triangle GAL. $\overline{TO}$ is 10 inches long, $\overline{OY}$ is 6 inches long, $\overline{GA}$ is 16 inches long, and $\overline{GL}$ is 13.8 inches long. How long is $\overline{TY}$?

What conjectures can you make if two similar polygons have a similarity ratio of 1? Draw an example to justify your conjectures.



Which quadrant has two similar polygons? Justify your answer.



BEAT THE TEST!

1. Which of the following polygons are always similar? Select all that apply.

   ☐ equilateral triangles
   ☐ isosceles triangles
   ☐ rectangles
   ☐ right triangles
   ☐ rhombi
   ☐ squares
   ☐ trapezoids

2. The areas of two similar polygons are in the ratio 25:81. Find the ratio of the corresponding sides.

3. In triangle ABC, angle A = 90° and angle B = 35°. In triangle DEF, angle E = 35° and angle F = 55°. Are the triangles similar? Prove your answer.

4. Four of the angle measures of a pentagon that Kym drew are $100°, 120°, 120°$, and $140°$. Her brother drew a pentagon that was congruent to Kym's. Which answer below represents one of the angle measures of her brother's pentagon?

- $30°$
- $42°$
- $60°$
- $160°$