


4.2 - Reflections

Lesson Objectives

 Perform reflections

- Perform glide reflections

 Identify lines of symmetry

- Solve real-life problems involving symmetry

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

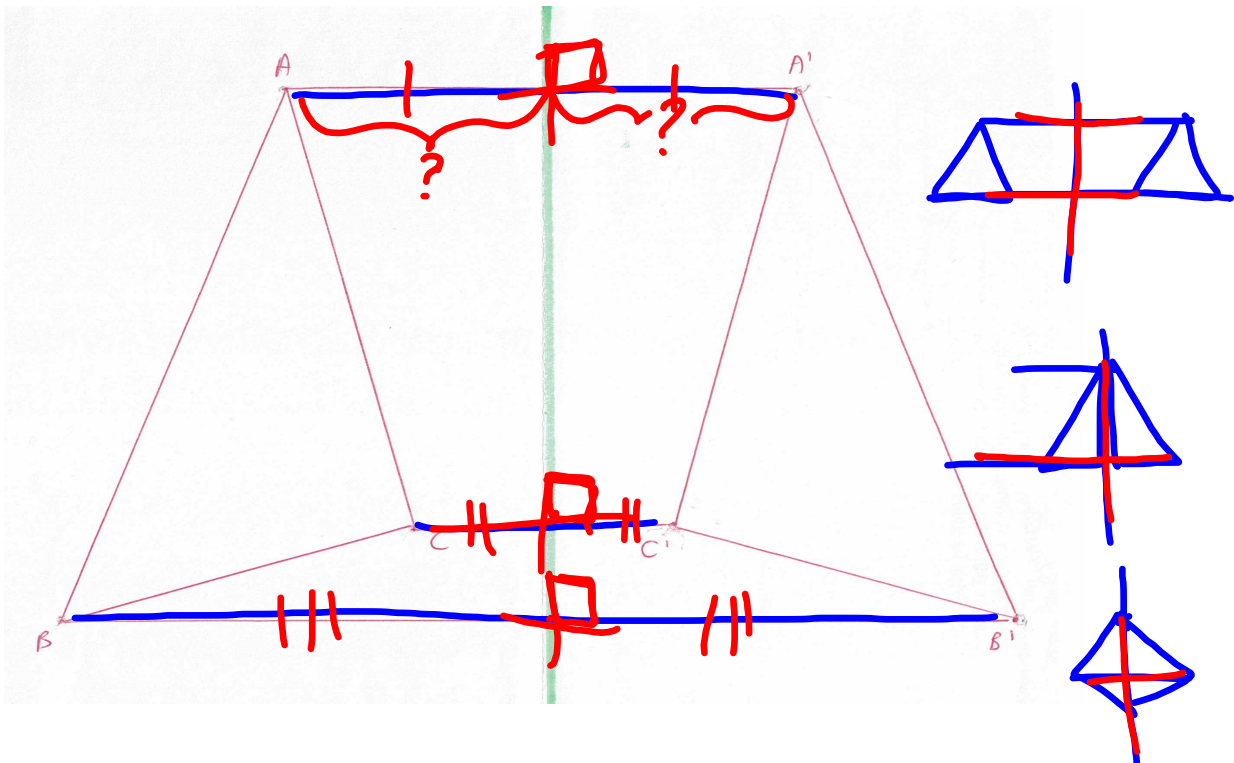
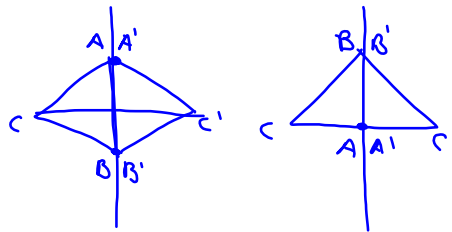
4.) Dilation (Dilate)

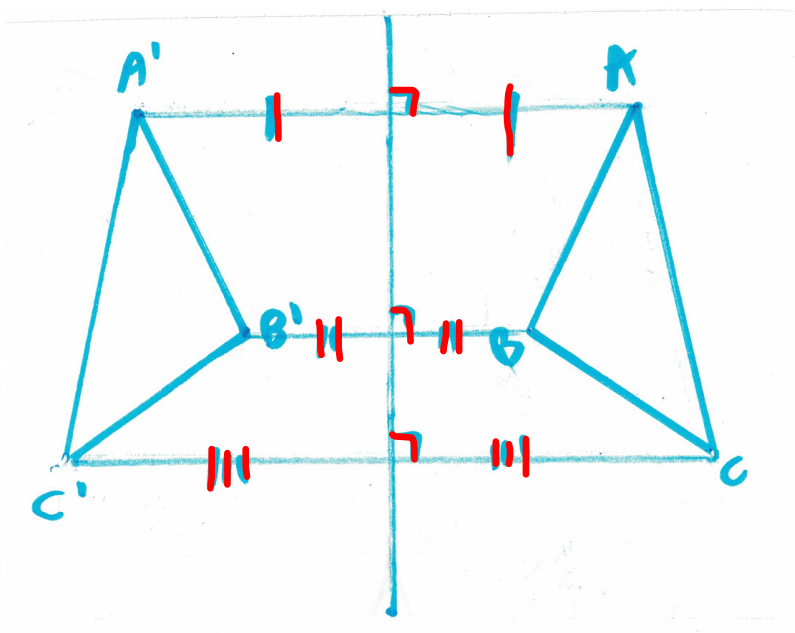
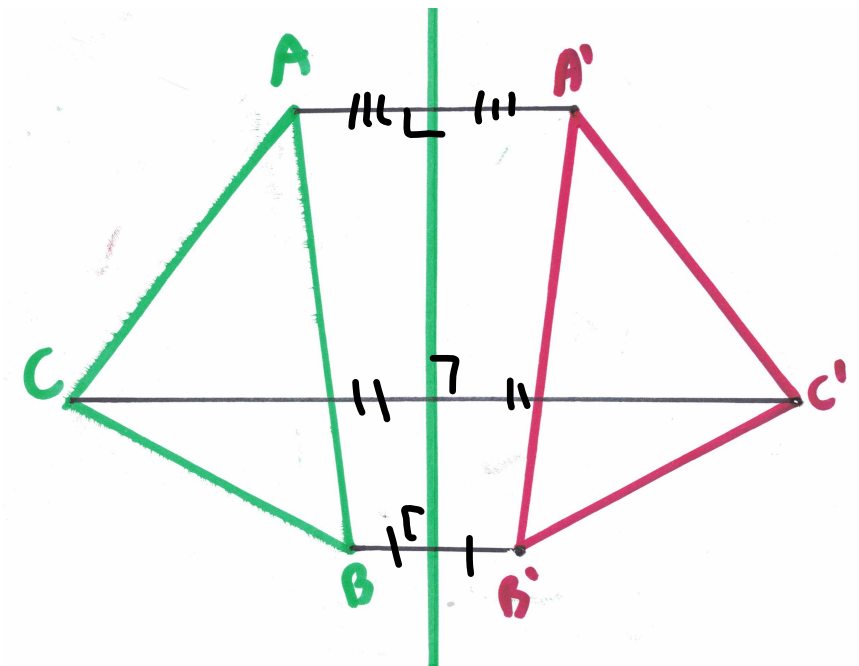
– Increase or decrease scale/size

Exploration - Reflecting a Triangle

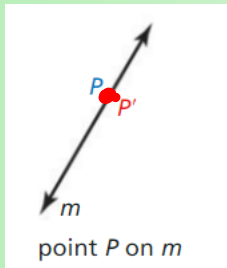
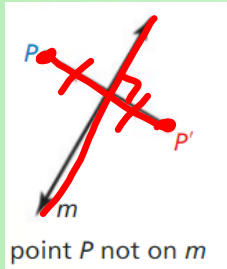
Each student will need a piece of paper, pencil, and ruler or straightedge.

1. Fold your paper in half along the long side (hamburger fold). Unfold it and use your straightedge to draw a line along the fold. Label the line m .
2. Use a ruler or a straightedge to draw any triangle on one half of your paper. Label it ABC .
3. Fold your paper again along the same fold so your triangle ABC is showing on the outside. Using a pen or pencil, poke a hole in your paper at each of the 3 vertices, A, B , and C .
4. Unfold your paper. You should have a hole at A, B , and C , along with 3 additional holes that are unlabeled. Draw points on your paper at these new locations and label them A', B' and C' to match up with your original triangle.
5. Connect each point with its image (new point) by drawing 3 segments, $\overline{AA'}$, $\overline{BB'}$, and $\overline{CC'}$.
6. Discuss and write down any observations you make regarding these 3 segments and line m .





Reflection = Reflects every point over a line of reflection to create a mirror image.



If P is not on the line of reflection, then:

- Line m is perpendicular to segment $\overline{PP'}$
- Line m bisects $\overline{PP'}$ 90° right angle

* distance from P to mirror is equal to mirror to P'

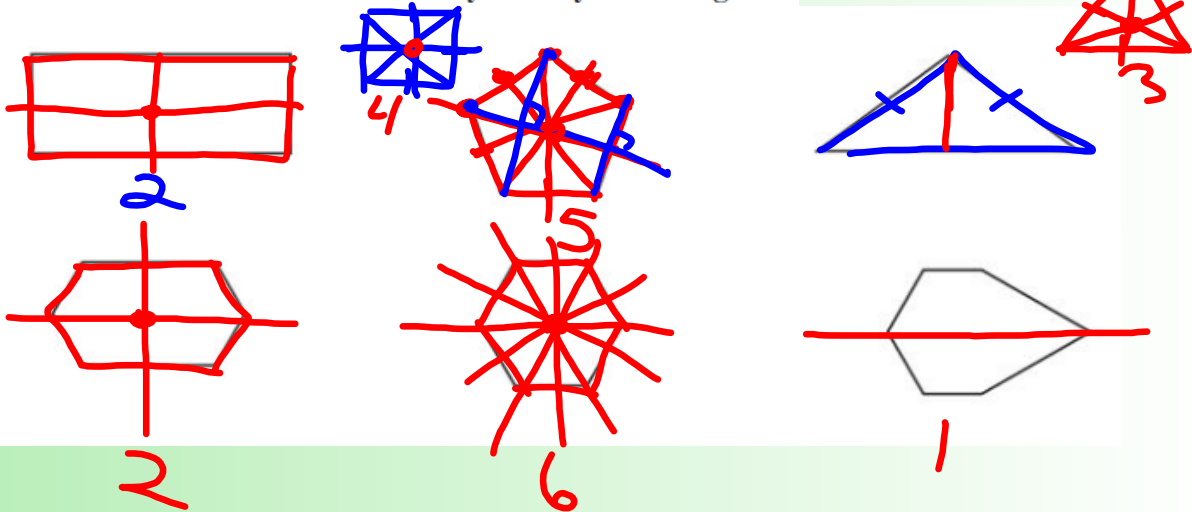
put into 2 equal parts

If P is on the line of reflection, then:

- $P=P'$ Points are same

Lines of Symmetry = Divide a shape so that the parts of the figure on each side of the line are mirror images.

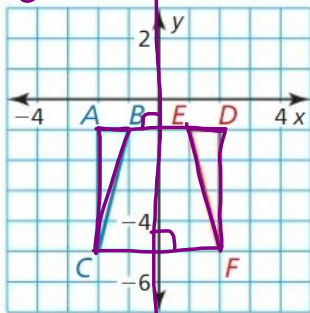
Determine the number of lines of symmetry for the figure.



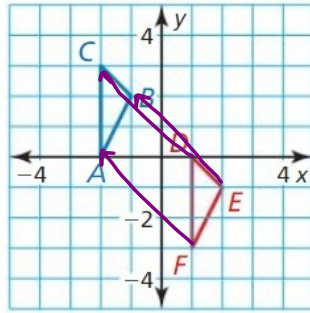
In Exercises 3–6, determine whether the coordinate plane shows a reflection in the x-axis, y-axis, or neither.

Homework

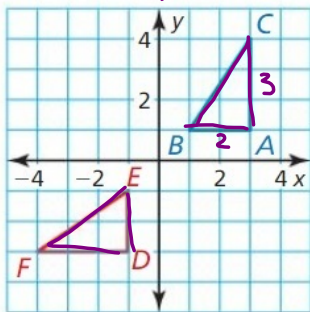
3. y axis reflection



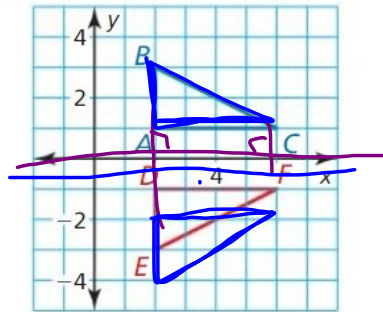
4. Neither, it's a translation



5. Neither



6. x axis

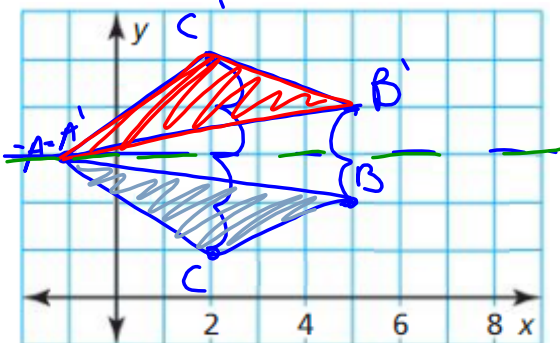


EXAMPLE 1 Reflecting in Horizontal and Vertical Lines

Graph $\triangle ABC$ with vertices $A(1, 3)$, $B(5, 2)$, and $C(2, 1)$ and its image after the reflection described.

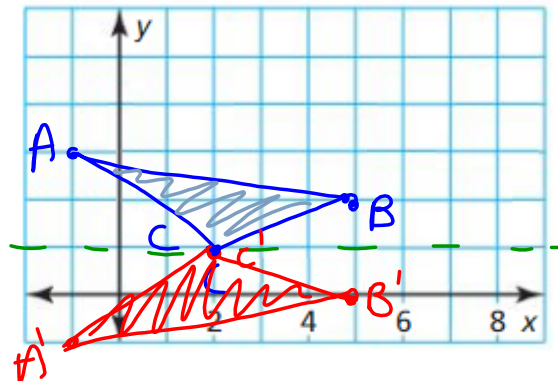
a. In the line $n: y = 3$

Horizontal line



b. In the line $m: y = 1$

Horizontal Line

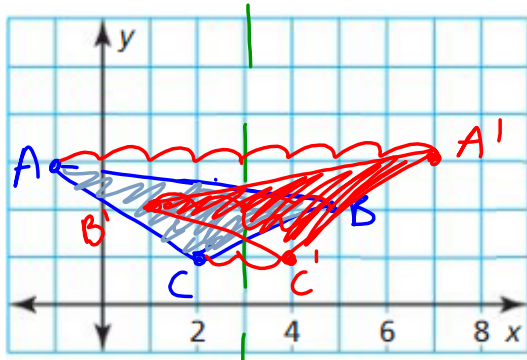


EXAMPLE 1 Reflecting in Horizontal and Vertical Lines

Graph $\triangle ABC$ with vertices $A(1, 3)$, $B(5, 2)$, and $C(2, 1)$ and its image after the reflection described.

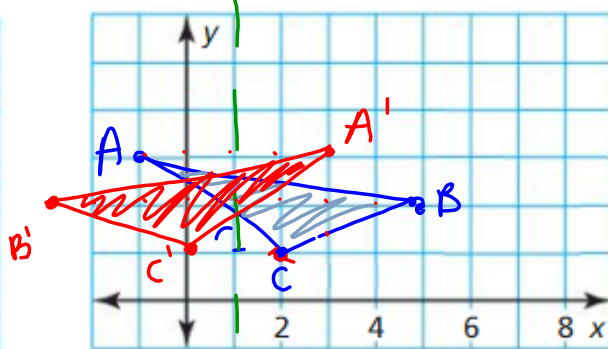
a. In the line $n: x = 3$

Vertical Line



b. In the line $m: x = 1$

Vertical Line

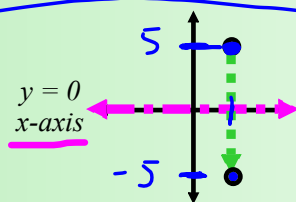


Coordinate Rules for Reflections

Reflection over x-axis

- x-value stays same
- y-value changes signs

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



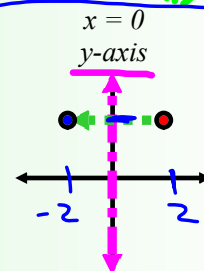
● Preimage (Original) ● Image (Final)

ex. $(2, 3) \rightarrow (2, -3)$
 $(5, -4) \rightarrow (5, 4)$

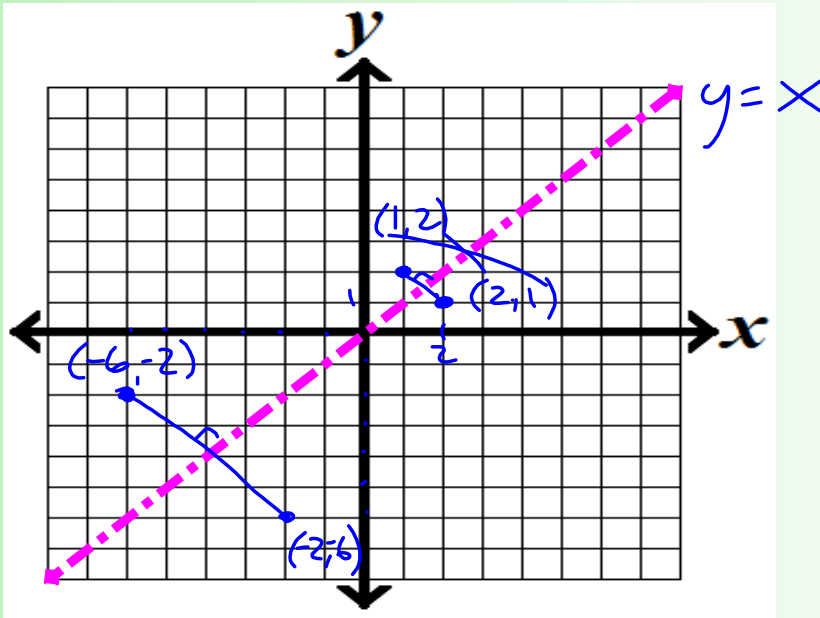
Reflection over y-axis

- x-value changes signs
- y-value stays same

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



ex. $(2, 3) \rightarrow (-2, 3)$
 $(-5, 4) \rightarrow (5, 4)$

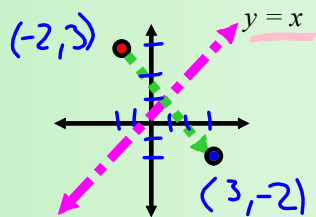


Coordinate Rules for Reflections

Reflection over line $y = x$

- x- and y-values flip

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



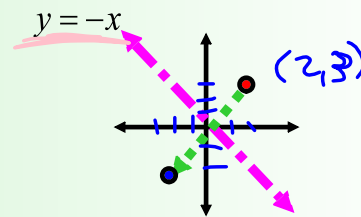
- Preimage (Original)
- Image (Final)

ex. $(-2, 3) \rightarrow (3, -2)$

Reflection over line $y = -x$

- x- and y-values flip and change signs

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

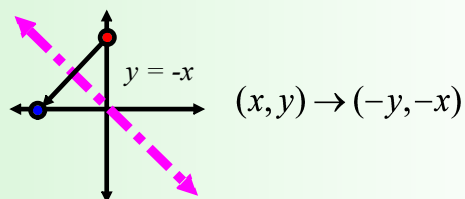
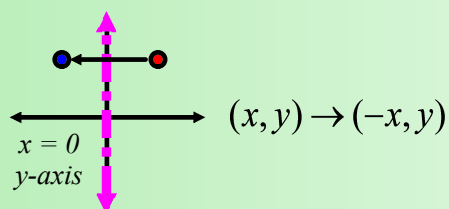
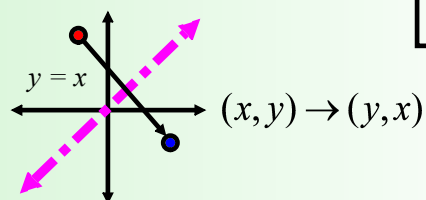
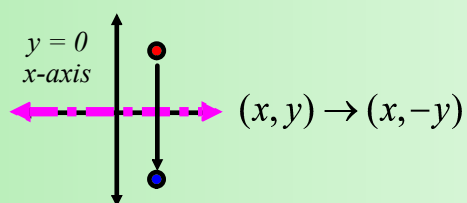


ex. $(2, 3) \rightarrow (-3, -2)$

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Part 1 #3-6, 8,14,16,17,20 (Tues 11/9)

Part 2 #21-24,28,30 (Wed 11/10)

Coordinate Rules for Reflections

- Preimage (Original)
- Image (Final)

Coordinate Rules for Reflections

- If (a,b) is reflected over the x -axis, then its image is $(a,-b)$
- If (a,b) is reflected over the y -axis, then its image is $(-a,b)$
- If (a,b) is reflected over the x -axis, then its image is (b,a)
- If (a,b) is reflected over the x -axis, then its image is $(-b,-a)$

● Preimage
(Original)

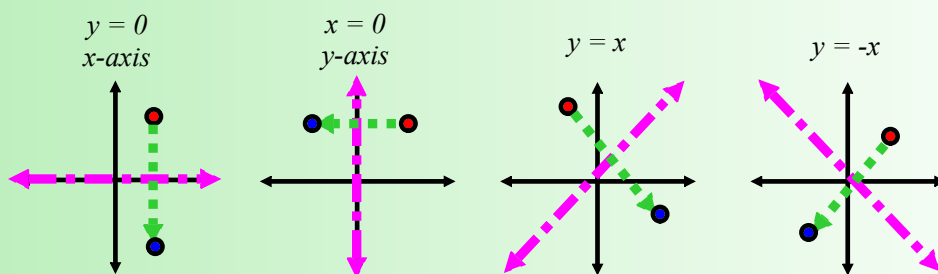
● Image
(Final)

Coordinate Rules for Reflections

- If a point is reflected over the x -axis, then the x -coordinate remains the same while the y -coordinate changes signs. $(x,y) \rightarrow (x,-y)$
- If a point is reflected over the y -axis, then the y -coordinate remains the same while the x -coordinate changes signs.

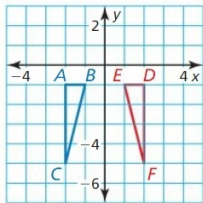
● Preimage
(Original)

● Image
(Final)

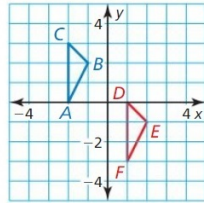


In Exercises 3–6, determine whether the coordinate plane shows a reflection in the x -axis, y -axis, or *neither*.

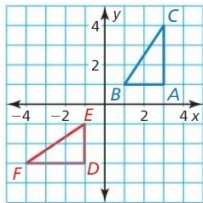
3.



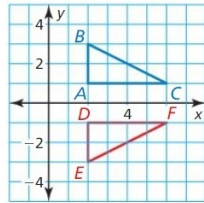
4.



5.

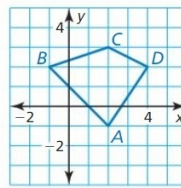


6.

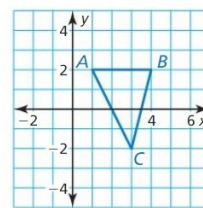


In Exercises 13–16, graph the polygon and its image after a reflection in the given line. (See Examples 2 and 3.)

14. $y = x$



16. $y = -x$



In Exercises 17–20, graph $\triangle RST$ with vertices $R(4, 1)$, $S(7, 3)$, and $T(6, 4)$ and its image after the glide reflection. (See Example 4.)

17. Translation: $(x, y) \rightarrow (x, y - 1)$
Reflection: in the y -axis

20. Translation: $(x, y) \rightarrow (x + 2, y + 2)$
Reflection: in the line $y = x$

In Exercises 7–12, graph $\triangle JKL$ and its image after a reflection in the given line. (See Example 1.)

- 8. $J(5, 3), K(1, -2), L(-3, 4); y$ -axis
- 10. $J(1, -1), K(3, 0), L(0, -4); x = 2$
- 12. $J(3, -5), K(4, -1), L(0, -3); y = -3$

Mental Floss: Thursday Nov 4th

Without graphing, determine the coordinates for both the first and second translations of the triangle below.



$\triangle XYZ$ with vertices $X(2,4)$, $Y(6,0)$, and $Z(7,2)$

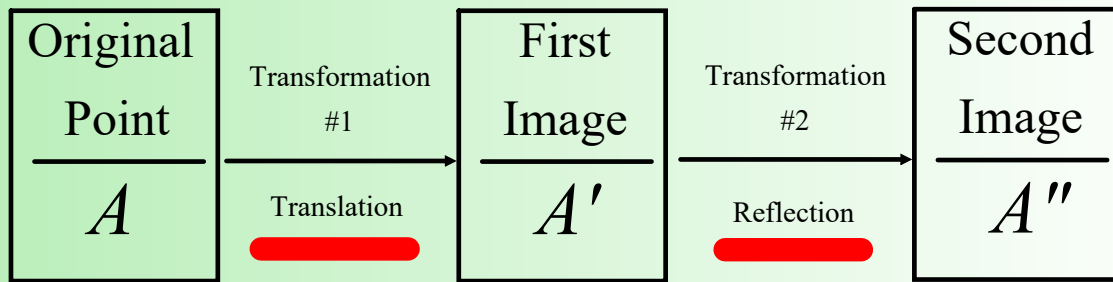
Translation: $(x, y) \rightarrow (x + 12, y + 4)$ *right 12 up 4*

Translation: $\langle -5, -9 \rangle$ *left 5 down 9*

$X(2,4) \rightarrow X'(14,8)$	\rightarrow	$X''(9,-1)$
$Y(6,0) \rightarrow Y'(18,4)$	\rightarrow	$Y''(13,-5)$
$Z(7,2) \rightarrow Z'(19,6)$	\rightarrow	$Z''(14,-3)$

Glide Reflection

A translation followed by a reflection.



- 1.) Write the component form of a vector that translates $P(5,-1)$ to $P'(-3,4)$.

$$\langle -8, 5 \rangle$$

$$\begin{array}{c} \xrightarrow{-8} \\ \xrightarrow{+5} \end{array}$$

- 2.) Write the vector from part (1) as a translation rule.

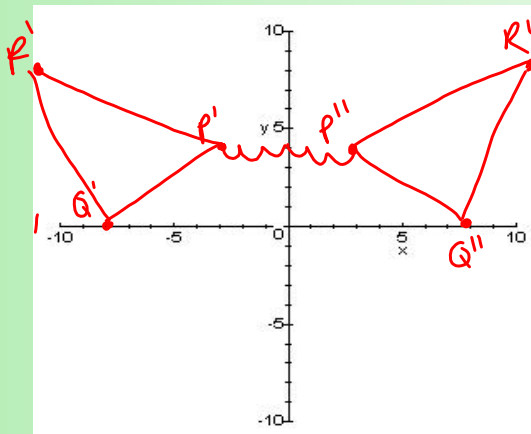
$$(x, y) \rightarrow (x - 8, y + 5)$$

- 3.) Apply this same translation to $Q(0,-5)$ and $R(-3,3)$.

$$Q(0, -5) \rightarrow Q'(-8, 0)$$

$$R(-3, 3) \rightarrow R'(-11, 8)$$

- 4.) Graph the vertices of triangle $P'Q'R'$. Then, list the coordinates (P'' , Q'' , and R'') when this triangle is reflected over the y -axis.



$$\begin{array}{l} (-x, y) \\ P''(3, 4) \\ Q''(8, 0) \\ R''(11, 8) \end{array}$$

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Part 1 #3-6 (Mon 11/8)

Part 2 #8,14,16,17,20 (Tues 11/9)

Part 3 #21-24,28,30 (Wed 11/10)

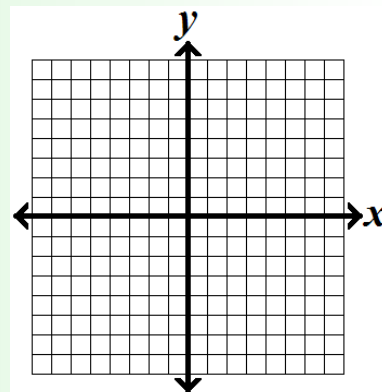
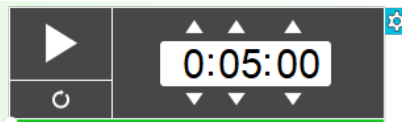
Mental Floss: Wednesday Dec 9th

Given the segment AB with endpoints at:

$$A(3, -4) \text{ and } B(5, 1)$$

List the coordinates when segment AB is transformed according to the rules (in order):

- 1.) $(x, y) \rightarrow (x - 4, y + 3)$
- 2.) Reflected over the y -axis

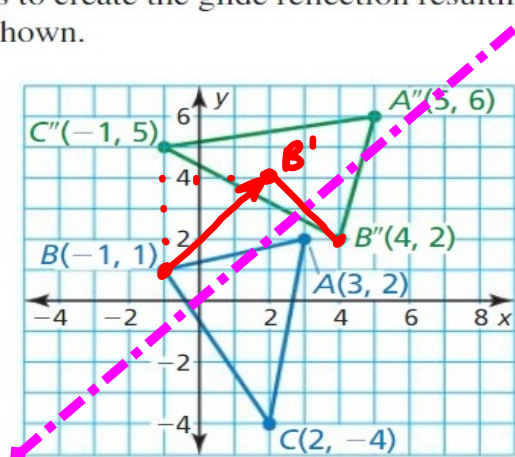


EXAMPLE 2 Reflecting in the Line $y = x$

Graph \overline{FG} with endpoints $F(-1, 2)$ and $G(1, 2)$ and its image after a reflection in the line $y = x$.

$$\begin{array}{l} F(-1, 2) \xrightarrow{(y, x)} F'(2, -1) \\ G(1, 2) \xrightarrow{(y, x)} G'(2, 1) \end{array}$$

28. **ATTENDING TO PRECISION** Use the numbers and symbols to create the glide reflection resulting in the image shown.



Translation: $(x, y) \rightarrow (x+3, y+3)$

Reflection: in $y = x$