# Lesson 24

REFLECT FIGURES USING COORDINATES

NY-8.G.3

INTRODUCTION

Real-World Connection

Marta is covering a large wall with a mosaic made of colorful tiles. She uses a coordinate plane to plan her artwork, and she plans to reflect the main figure across the y-axis in her design. What are the coordinates of the new image? Let's practice the skills in the **Guided Instruction** and **Independent Practice** and see what the new coordinates are at the end of the lesson!
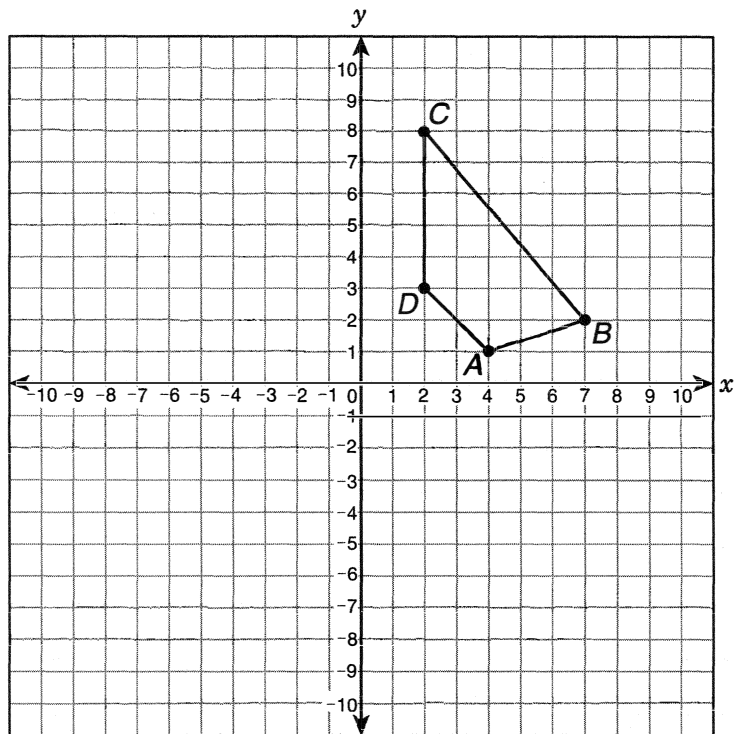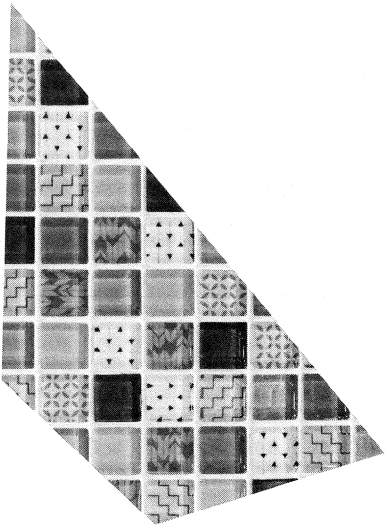
What I Am Going to Learn

- How to reflect figures in the coordinate plane

- How the coordinates of a figure change when the figure is reflected

What I May Already Know

- I know how to plot points in the coordinate plane.

- I know how to draw a polygon in the coordinate plane, given coordinates of the vertices.

- I know how to find the lengths of sides in these polygons using the coordinates.

- I know how to prove congruence in a transformation or series of transformations.

Vocabulary in Action

A **reflection** is a type of rigid transformation.

- A reflection "flips" the **pre-image** over a line, called the **line of reflection,** or line of **symmetry,** to make the **image**.

- The line of reflection, or symmetry, is often the x-axis or y-axis.

- When a figure is reflected, its position changes, but not its size or shape.

- The corresponding points of the pre-image and image are the same distance from the line of reflection.

If a figure is drawn in the coordinate plane, the reflection can be described using the coordinates of the figure.

- A point reflected across the x-axis moves the point (x, y) to $(x, -y)$.

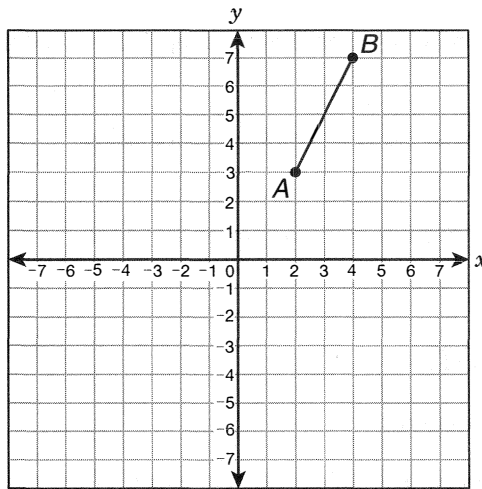- A point reflected across the y-axis moves the point (x, y) to $(-x, y)$.

◀ **TIPS AND HINTS**

Remember the y-axis is vertical and the x-axis is horizontal. An easy way to remember this is that the letter Y has a vertical line in it and X does not!

EXAMPLE

Reflect line segment AB across the y-axis.

Step One Identify the coordinates of A and B.

Point A is located at $(2, 3)$.

Point B is at $(4, 7)$.

Step Two Determine the coordinates of the image after the reflection and graph the image.
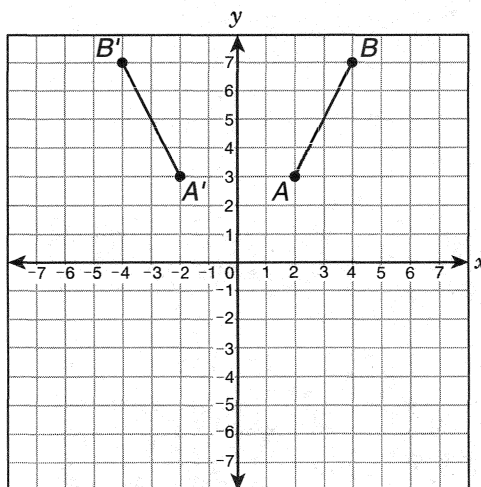
Because AB is reflected across the y-axis, the y-coordinate stays the same.

The x-coordinate is 2 units from the y-axis. For it to be mirrored, it will be 2 units from the axis in the other direction.

So,

$A(2, 3)$ will become $A'(-2, 3)$.
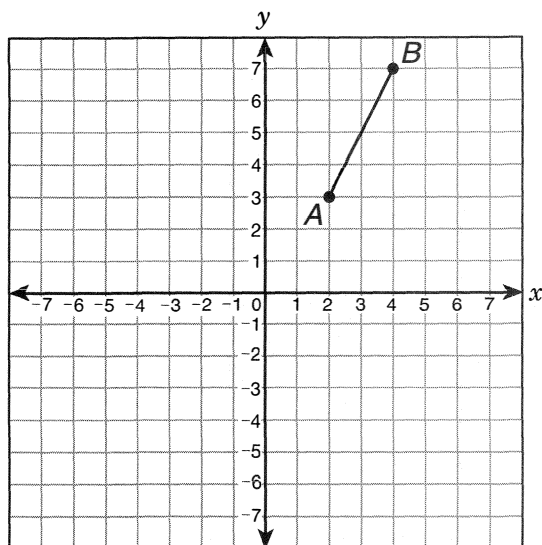
$B(4, 7)$ will become $B'(-4, 7)$.

▶ **THINK ABOUT IT**

Notice that if you folded the coordinate plane on the y-axis, the line segments would match.

Reflecting across the x-axis is similar.

EXAMPLE
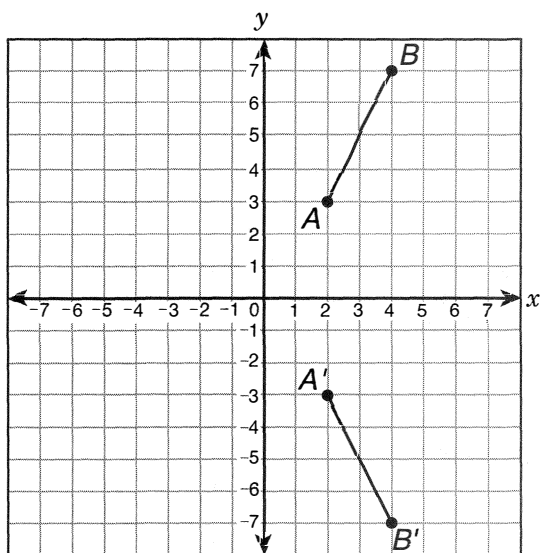
Reflect line segment AB across the x-axis.

Step One Identify the coordinates of A and B.

Point A is located at (2, 3).

Point B is at (4, 7).

Step Two Determine the coordinates of the image after the reflection, and graph the image.


◀ TURN AND TALK

If you knew the coordinates of the pre-image and image, could you tell which axis it was reflected across? If so, how?
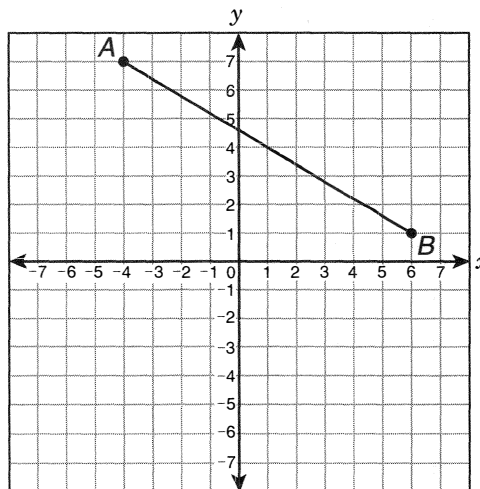
◀ SKETCH IT

Where would A'B' be on the coordinate plane if AB was reflected across the y-axis, then the x-axis?

GUIDED INSTRUCTION

You see reflections in everyday life. When you look in a mirror or in a body of water, you see a reflection or a mirror image.
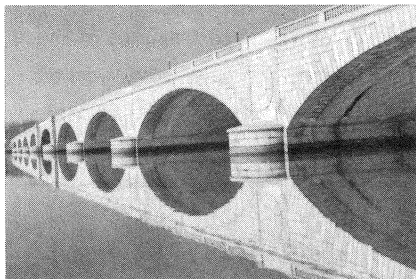
1. Reflect the line segment across the *x*-axis.

▶ **THINK ABOUT IT**

The distances of points *A* and *B* from the *y*-axis are the absolute values of their *y*-coordinate.

Step One Find the coordinates of both endpoints.
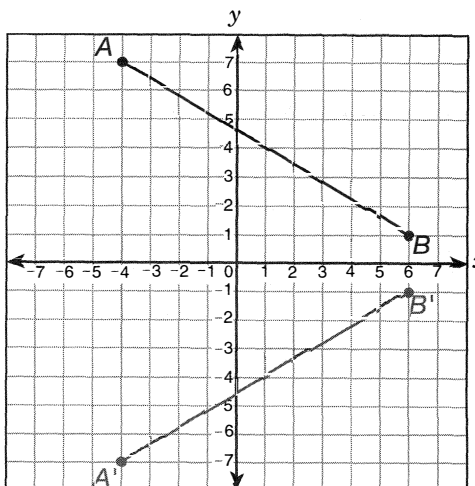
$A(-4, 7)$

$B(6, 1)$

Step Two Find the coordinates of the endpoints in the image.

Because the reflection is across the *x*-axis, the *y*-coordinates will change signs.

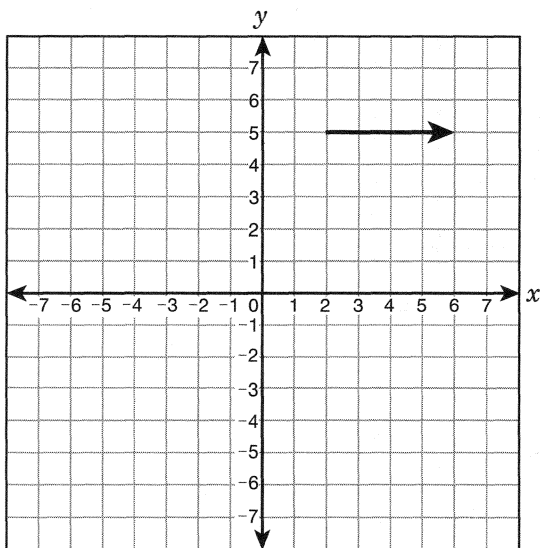$A(-4, 7) \rightarrow A'(-4, -7)$

$B(6, 1) \rightarrow B'(6, -1)$

Step Three Draw the line segment.

2. The arrow below is reflected across the *y*-axis. Describe the direction in which the image of the arrow points and the coordinates of its tip. The tip in the pre-image is located at **(6, 5)**.

Step One Determine where the arrow will point when it is reflected across the *y*-axis.

The direction of the arrow in the pre-image points to the right.

Since we are reflecting across the vertical axis and the figure will be mirrored, the direction of the arrow in the image will point to the

```
[          ].
```

Step Two Find the coordinates of the tip in the pre-image, then the image.

The coordinates of the arrowhead in the image will be:

$(6, 5) \rightarrow ($ [   ] $, 5)$

The arrow stays the same height above the *x*-axis and the same distance from the *y*-axis, but the direction of the arrow changes.
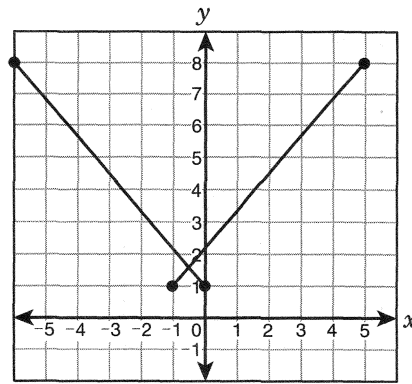
◀ TURN AND TALK

How are reflections related to symmetry and lines of symmetry?
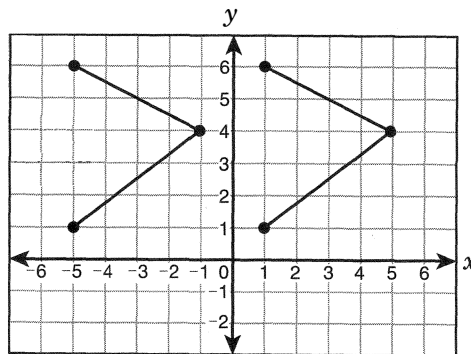
▶ **TIPS AND HINTS**

Think about which coordinates change when an image is reflected across the y-axis.

3. Which two figures below show a reflection across the y-axis?

(A)

(B)

(C)
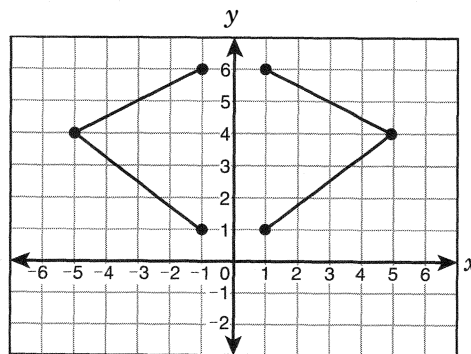
(D)
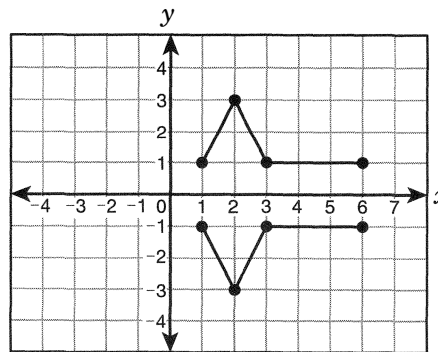
Learning Together

Working with a partner, simulate a person (*P*) and the person's image (*P′*) in a mirror. Note where the right arm of *P* is compared to that of *P′*. Note where the nose of *P* is compared to that of *P′*. Discuss how a mirror image relates to a reflection on the coordinate grid.

II II II II II II II II II II II II

How Am I Doing?

What questions do you have?

In the margin to the left, draw a triangle on the coordinate plane.

How can you reflect it across either axis?

Where do you see reflections besides in a mirror? Are there any common designs or logos that use reflections?

Circle the sign that shows how you are doing with the skill.

STOP

I am stuck.

YIELD

I almost have it.

I understand the skill.

INDEPENDENT PRACTICE 1

1 A pre-image and an image are shown on the coordinate plane below.
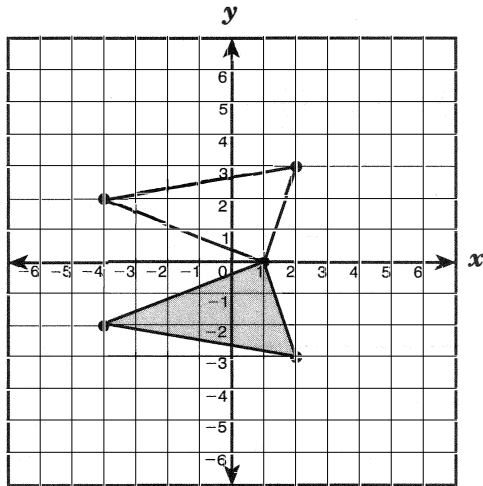
Which reflection does the image show?

A   reflection across the x-axis according to the rule $(x, y) \rightarrow (x, -y)$

B   reflection across the y-axis according to the rule $(x, y) \rightarrow (x, -y)$

C   reflection across the x-axis according to the rule $(x, y) \rightarrow (-x, y)$

D   reflection across the y-axis according to the rule $(x, y) \rightarrow (-x, y)$

2 Triangle ABC is shown on the coordinate plane below.

A reflection is applied to triangle *ABC* according to the rule $(x, y) \rightarrow (-x, y)$. Which of the following will be the top vertex of the image?

A $(2, -4)$

B $(-1, 1)$

C $(-2, 4)$

D $(1, -1)$

3 Triangle *ABC* is shown on the coordinate plane below.

A reflection is applied to triangle *ABC* according to the rule $(x, y) \rightarrow (-x, y)$. Which point will be the top vertex of the image?

A $(-3, -4)$

B $(-1, 2)$

C $(3, 4)$

D $(1, -2)$
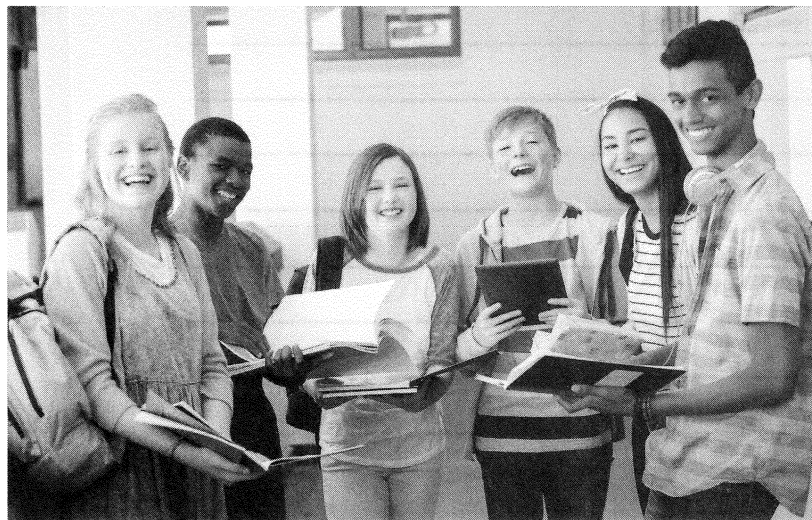
4 Some letters of the alphabet are symmetrical. If they are symmetrical, you can create them by taking half of the letter and reflecting it across an axis. Make a list of capital letters you could create with a pre-image of half of the letter and its image after reflection. What must be true about the pre-image for the transformation to work?

◀ SKETCH IT

To help you "see" which axis a letter would reflect over, draw a line of symmetry on each letter.

Explain your answer.

_____

_____

_____

_____

_____

_____

_____

_____
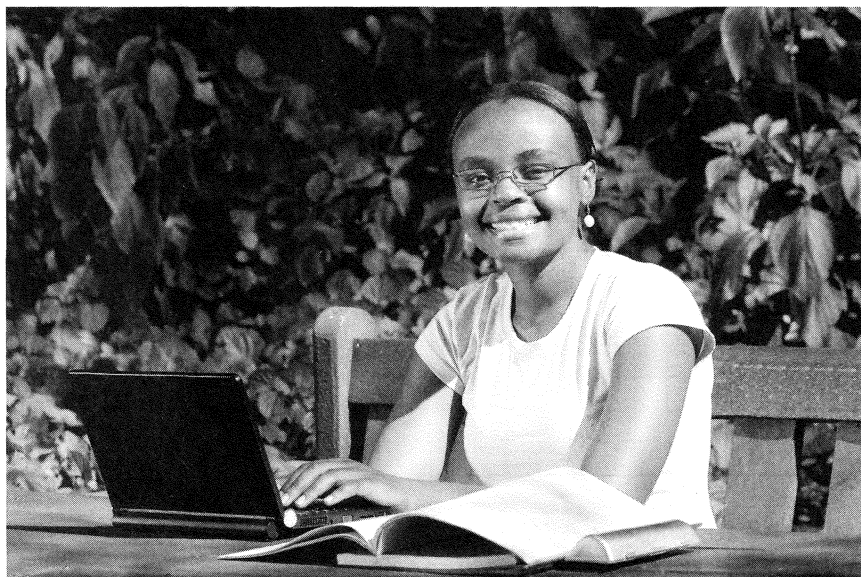
INDEPENDENT PRACTICE 2

1   Which of the following are the coordinates of the point (8, 7) when reflected across the *y*-axis?

    A   (7, 8)   **C**   (−8, 7)

    B   (8, −7)   **D**   (−8, −7)

2   The figure shown below is transformed by the rule $(x, y) \rightarrow (x, -y)$.
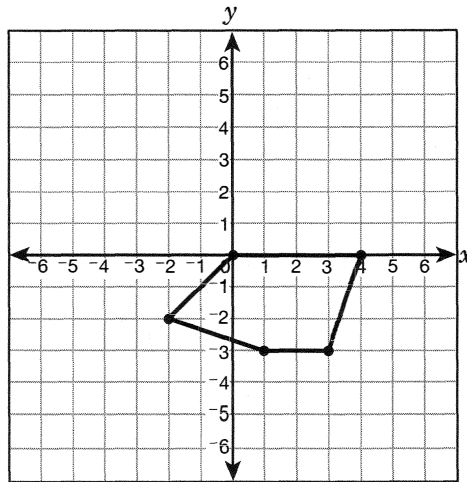
How many coordinates have vertices that will remain unchanged?

    A   0   **C**   2

    B   1   **D**   5

3   If the point (−7, −8) is the image found after reflecting a point across the *y*-axis, what was the location of the pre-image?

    A   (−7, −8)

    B   (−7, 8)

    C   (7, −8)

    D   (7, 8)

4 Which point could be the result when (5, −6) is reflected across one of the axes in the coordinate grid?

A   (−5, −6)   C   (5, −6)

B   (−5, 6)   D   (−6, 5)

5 A line segment is shown on a coordinate plane below.
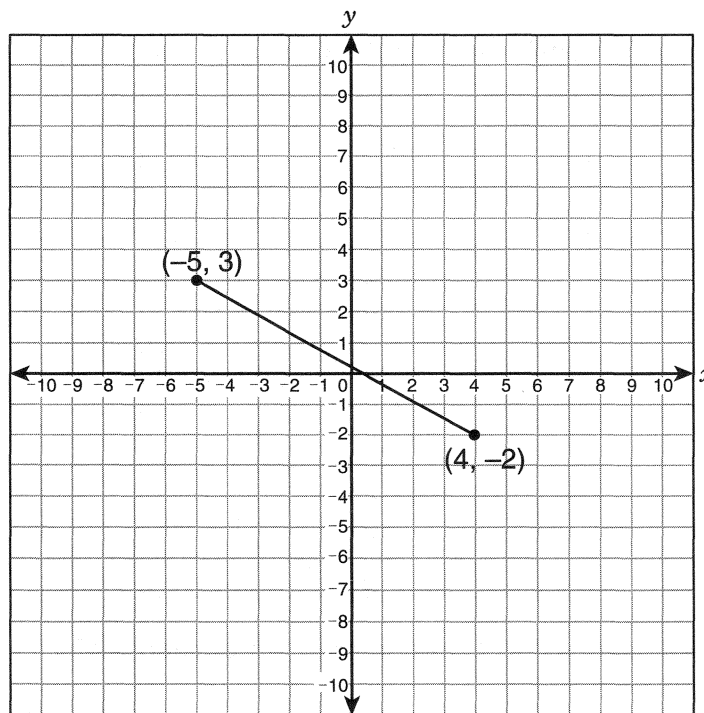
When reflected across the x-axis, what will be the coordinates of the endpoints of the reflected line?

A   (5, −3), (−4, 2)   C   (−5, −3), (−4, −2)

B   (−5, −3), (4, 2)   D   (5, 3), (4, 2)

6 If you reflected the point (10, −8) across the x-axis and then reflected the new point across the y-axis, what would be the final coordinates of the new point?

A   (10, 8)   C   (−10, 8)

B   (10, −8)   D   (−10, −8)

7 A translation moved point A (2, 1) to point A' (4, 3), and then a second translation moved point A' to point A" (6, 1). Point B, which has coordinates of (1, 3), will be translated using the same rules as for the translation of point A. What are the coordinates of point B"?
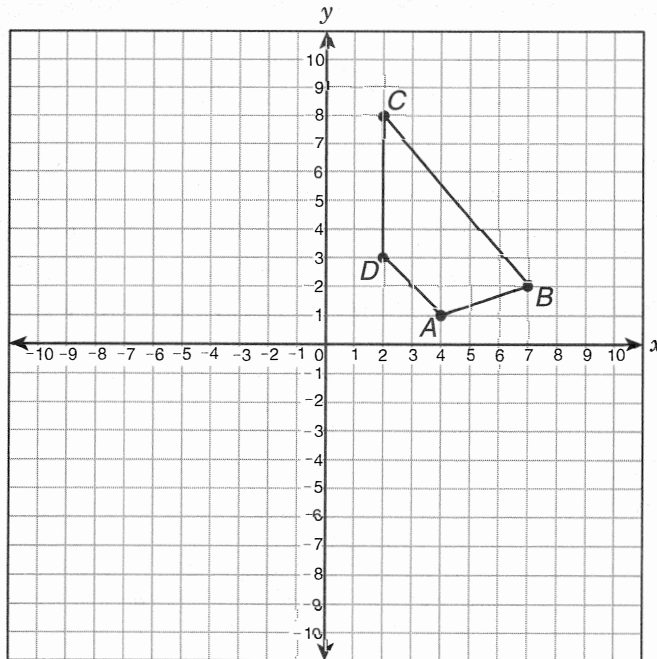
A   (1, 3)   **C**   (3, 5)

B   (1, 7)   **D**   (5, 3)

8 The coordinate plane below shows a pre-image that has been reflected over the x-axis, then over the y-axis, and then over the x-axis.

Describe the coordinates of the points closest to the x-axis in each of the three reflected images compared to the coordinates of those points in the pre-image. Include the rules for changing the coordinates.

Explain your answer.

_____

_____

_____

_____

_____

9 The figure below shows a hexagon on a coordinate plane.

How will the two hexagons appear in relation to each other?

Explain your answer.

_____

_____

_____

_____

_____

_____
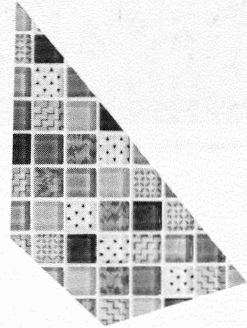
EXIT TICKET

Now that you have mastered reflections, let's solve the problem in the **Real-World Connection**.

Marta is covering a large wall with a mosaic made of colorful tiles. She uses a coordinate plane to plan her artwork, and she plans to reflect the main figure across the y-axis in her design. What are the coordinates of the new image?

Explain your answer.

_____

_____

_____

_____

_____

_____

_____

_____