

## PRACTICE WITH POINTS

- Want more basic practice with the coordinate plane and points first?  
[Locating Points in Quadrants and on Axes](#)



([more mathematical cats](#)).

As discussed in [Locating Points in Quadrants and on Axes](#), an **ordered pair**  $(x, y)$  is a pair of numbers, separated by a comma, and enclosed in parentheses.

The number that is listed first is called the **first coordinate** or the ***x*-value**. The number that is listed second is called the **second coordinate** or the ***y*-value**.

The **coordinate plane** (also called the ***xy*-plane**) is a device to ‘picture’ ordered pairs. Each ordered pair corresponds to a point in the coordinate plane, and each point in the coordinate plane corresponds to an ordered pair. For this reason, ordered pairs are often called **points**. Recall that the **origin** is the point  $(0, 0)$ .

This section gives you practice with the connection between ordered pairs and movement in the coordinate plane.

### MOVING UP/DOWN/LEFT/RIGHT

Left/right movement is controlled by the ***x*-value** (the first coordinate). Moving to the right increases the ***x*-value**; moving to the left decreases it. For example, if a point  $(a, b)$  is moved two units to the right, then the new coordinates are  $(a + 2, b)$ . If a point  $(a, b)$  is moved three units to the left, then the new coordinates are  $(a - 3, b)$ .

Up/down movement is controlled by the ***y*-value** (the second coordinate). Moving up increases the ***y*-value**; moving down decreases it. For example, if a point  $(a, b)$  is moved four units up, then the new coordinates are  $(a, b + 4)$ . If a point  $(a, b)$  is moved five units down, then the new coordinates are  $(a, b - 5)$ .

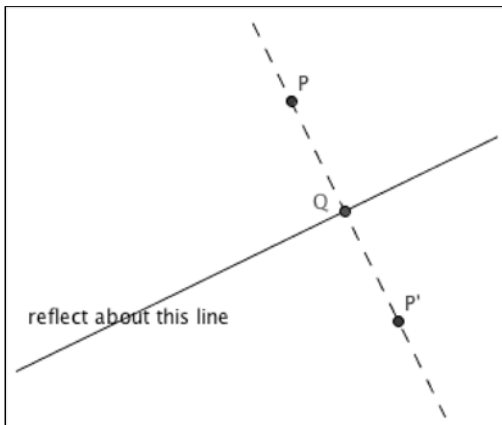
Recall that the **origin** is the point  $(0, 0)$ .

### REFLECTING A POINT ABOUT A LINE

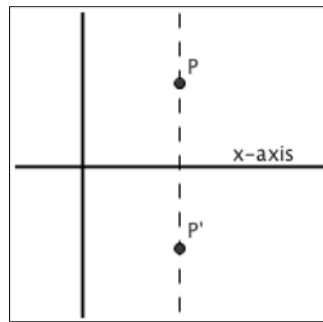
Suppose you have a line drawn on a piece of paper. On this same piece of paper, you have a point. For the moment, suppose that the point does **not** lie on the line.

To ‘reflect the point about the line’ means, roughly, that you want the point that is the **same distance from the line**, but on **the other side of the line**.

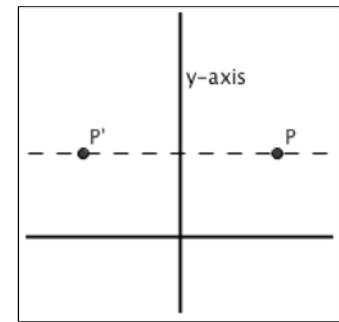
This idea is illustrated below:



reflecting about an arbitrary line:  
the distance from P to Q is the same as  
the distance from P' to Q.  
(the coordinates of the reflected point  
are not so easy to find)



reflecting about the  $x$ -axis  
(the  $x$ -value stays the same;  
take the opposite of the  $y$ -  
value)



reflecting about the  $y$ -axis  
(the  $y$ -value stays the same;  
take the opposite of the  $x$ -  
value)

Notice that if you fold the piece of paper along the line of reflection,  
then the original point and its reflection will land right on top of each other.

It's kind of like reflecting in a mirror —except instead of the mirror reflecting ‘back at you’,  
it instead projects to the other side.

If a point actually lies *on* the line that you're reflecting about, then the reflection of the point is itself.

### EXAMPLES:

**Question:** Start at the origin.  
Move to the right 2, and down 4.  
At what point are you?

**Solution:**  $(2, -4)$

Why?

$$(0, 0) \xrightarrow{\text{right } 2} (0 + 2, 0) = (2, 0) \xrightarrow{\text{down } 4} (2, 0 - 4) = (2, -4)$$

**Question:** Start at the point  $(1, -3)$ .  
Move to the left 4, and up 2.  
At what point are you?

**Solution:**  $(-3, -1)$

Why?

$$(1, -3) \xrightarrow{\text{left } 4} (1 - 4, -3) = (-3, -3) \xrightarrow{\text{up } 2} (-3, -3 + 2) = (-3, -1)$$

**Question:** Start at the point  $(-2, 5)$ .

Stay in the same quadrant,  
but double your distance from the  $x$ -axis,  
and triple your distance from the  $y$ -axis.  
At what point are you?

**Solution:**  $(-6, 10)$

Why?

The up/down info (the  $y$ -value) gives distance from the  $x$ -axis.

The left/right info (the  $x$ -value) gives distance from the  $y$ -axis.

Thus:

$$(-2, 5)$$

original point:

currently 5 units from the  $x$ -axis (above)  
and 2 units from the  $y$ -axis (to the left)

$$(-2, 5 \cdot 2) = (-2, 10)$$

double distance from  $x$ -axis; stay above

$$(-2 \cdot 3, 10) = (-6, 10)$$

triple distance from  $y$ -axis, stay to the left

**Question:** Start at the point  $(-3, 7)$ .

Reflect about the  $x$ -axis.

At what point are you?

**Solution:**  $(-3, -7)$

To reflect about the  $x$ -axis,  
the  $x$ -value stays the same,  
and you take the opposite of the  $y$ -value.

**Question:** Start at the point  $(-3, 7)$ .

Reflect about the  $y$ -axis.

At what point are you?

**Solution:**  $(3, 7)$

To reflect about the  $y$ -axis,  
the  $y$ -value stays the same,  
and you take the opposite of the  $x$ -value.

**Question:** Start at the point  $(-3, 7)$ .

Reflect about the  $x$ -axis, and then reflect about the  $y$ -axis.

At what point are you?

**Solution:**  $(3, -7)$

Why?

$$(-3, 7) \xrightarrow{\text{reflect about } x\text{-axis}} (-3, -7) \xrightarrow{\text{reflect about } y\text{-axis}} (3, -7)$$

**Question:** Start at the point  $(-3, 1)$ .

Reflect about the vertical line that passes through the  $x$ -axis at 2.

At what point are you?

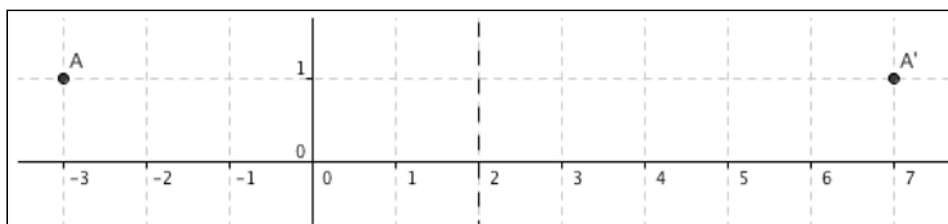
**Solution:**  $(7, 1)$

Why?

On this problem, you need to stop and think.

It might be helpful to make a sketch (see below).

- Since you're reflecting about a vertical line, the  $y$ -value won't change. It was 1, and it will remain 1.
- Figure out the distance from the point to the line:  $2 - (-3) = 5$   
You need to go this far on the *other* side of the vertical line:  $2 + 5 = 7$   
So, the new  $x$ -value is 7.



**Question:** Start at the point  $(-3, 1)$ .

Reflect about the horizontal line that passes through the  $y$ -axis at 4.

At what point are you?

**Solution:**  $(-3, 7)$

Why?

Again, you need to stop and think.

Again, a sketch may be helpful (see below).

- Since you're reflecting about a horizontal line, the  $x$ -value won't change. It was  $-3$ , and it will remain  $-3$ .
- Figure out the distance from the point to the line:  $4 - 1 = 3$   
You need to go this far on the *other* side of the horizontal line:  $4 + 3 = 7$   
So, the new  $y$ -value is 7.

