Common Core State Standards:
6.NS.6.b, 6.NS.8

Solve Problems in the Coordinate Plane

Getting the Idea

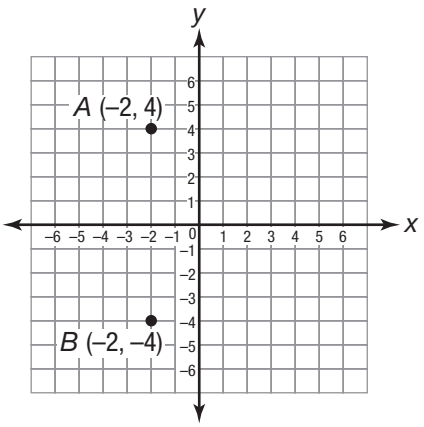
A point can be flipped over a line. The new point is called the **reflection** of the original point. When a point is reflected across the *x*-axis, the *y*-axis, or both axes on a coordinate plane, the signs of one or both coordinates will change. The new point also will be in a different quadrant.

Example 1

Plot point *A* at (−2, 4) on the coordinate plane. Then plot point *B* at (−2, −4). Compare the coordinates and locations of points *B* and *A*.

Strategy **Plot points *A* and *B* on a coordinate plane. Compare their coordinates. Describe how one point is a reflection of the other.**

Step 1 Plot point *A* at (−2, 4) and point *B* at (−2, −4).



Step 2 Compare their coordinates.

Both ordered pairs have the same *x*-coordinate, −2.

The *y*-coordinates of the ordered pairs are 4 and −4.

They have different signs.

Step 3 Describe the locations of the points.

Both points lie on the same vertical line, $x = -2$.

Point *A* is in quadrant II and is 4 units *above* the *x*-axis.

Point *B* is in quadrant III and is 4 units *below* the *x*-axis.

So, point *B* is a reflection of point *A* over the *x*-axis.

If you folded the grid along the *x*-axis, point *A* would fold onto point *B*.

Solution **The coordinate plane above shows points *A* and *B*. The points are reflections of each other across the *x*-axis, and their *y*-coordinates have different signs.**

The statements below show the relationship between reflected points and the signs of their coordinates.

- If a point (x, y) is reflected across the x-axis, the sign of its y-coordinate changes.

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

- If a point (x, y) is reflected across the y-axis, the sign of its x-coordinate changes.

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

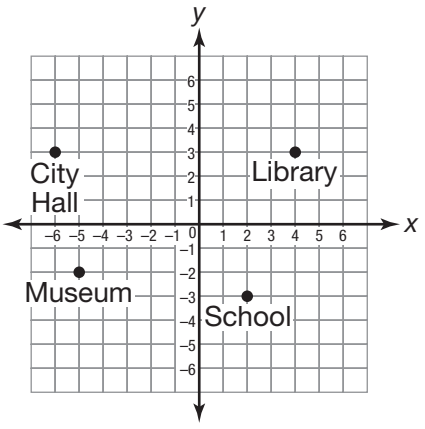
- If a point (x, y) is reflected across both axes, the signs of both of its coordinates change.

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

You can use absolute value to find the distance between two points on a coordinate plane. Each axis on a coordinate plane is a number line. Since the absolute value of a number is its distance from zero on a number line, you can use absolute values to find horizontal and vertical distances on the coordinate plane.

Example 2

A map of some important places in Carr County is shown at the right. What is the distance, in kilometers, between City Hall and the library?



Scale: ⊢ = 1 kilometer

Strategy **Use absolute values to find the distance between points. Then use the scale to find the distance in kilometers.**

Step 1 Identify the ordered pairs.

City Hall is at $(-6, 3)$.
The library is at $(4, 3)$.

Step 2 Use absolute value to find the distance from City Hall to the y-axis.

Think of the line $y = 3$ as a horizontal number line.

Zero on that number line is the point at which $y = 3$ crosses the y-axis, or where $x = 0$.

The x-coordinate for City Hall is -6.

$|-6| = 6$

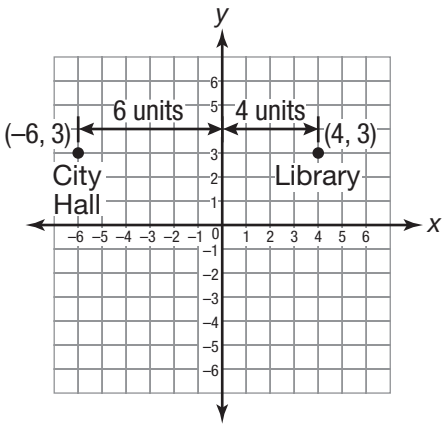
The distance between City Hall and the y-axis is 6 units.

Step 3 Use absolute value to find the distance from the public library to the *y*-axis.

The *x*-coordinate for the library is 4.

$|4| = 4$

The distance between the library and the *y*-axis is 4 units.



Scale: ⊢ = 1 kilometer

Step 4 Add the absolute values to find the total distance.

The total distance between City Hall and the library on the map is:

$6 + 4 = 10$ units

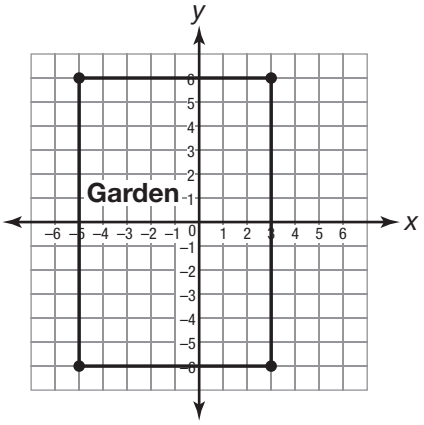
Each unit on the map represents 1 kilometer, so the actual distance is 10 kilometers.

Solution **The distance between City Hall and the library is 10 kilometers.**

You can also use absolute values to find the **perimeter** of a figure on a coordinate plane.

Example 3

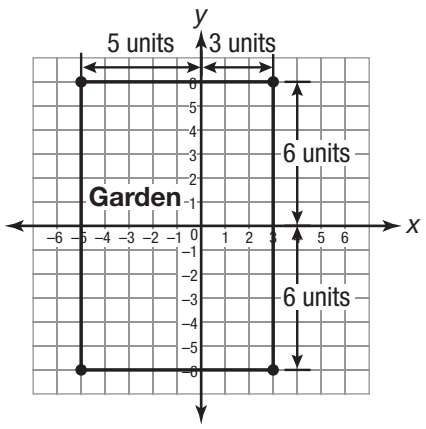
A rectangular garden is shown below. What is the perimeter of the garden?



Scale: ⊢ = 1 yard

Strategy **Use absolute values to find the length of one vertical side and one horizontal side. Then find the perimeter.**

Step 1 Use absolute value to find the length of a vertical side.



Scale: ⊢ = 1 yard

The endpoints of one vertical side are (3, 6) and (3, −6).

Think of the line $x = 3$ as a vertical number line.

Zero on that number line is the point at which $x = 3$ crosses the x-axis, or (3, 0).

The y-coordinates for the endpoints are 6 and −6.

$|6| = 6$ $\quad$ $|-6| = 6$

The total length of a vertical side is: $6 + 6 = 12$ units

Step 2 Use absolute value to find the length of a horizontal side.

The endpoints of one horizontal side are (−5, 6) and (3, 6).

The x-coordinates of the endpoints are −5 and 3.

$|-5| = 5$ $\quad$ $|3| = 3$

The total length of the horizontal side is: $5 + 3 = 8$ units

Step 3 Find the perimeter.

Opposite sides in a rectangle are the same length, so add the lengths of all four sides to find the perimeter, P.

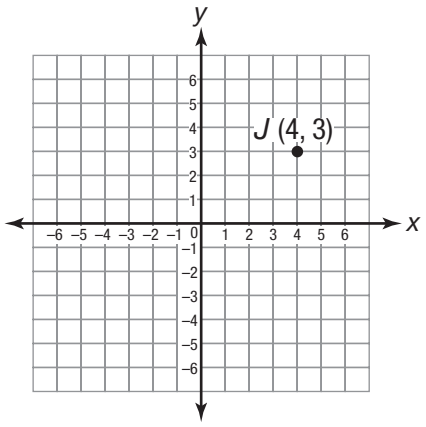
$P = 12 + 8 + 12 + 8 = 40$ units

Each unit on the coordinate plane stands for 1 yard, so the actual perimeter is 40 yards.

Solution **The perimeter of the garden is 40 yards.**

Coached Example

Point *J* below at (4, 3) can be reflected across one or more axes to form a point at (−4, −3). Describe the reflection(s) that are needed.



Compare the signs of the coordinates in (4, 3) and (−4, −3).

The *x*-coordinates of the ordered pairs have different signs.

The ____-coordinates of the ordered pairs have different signs, too.

Would point *J* need to be reflected across the *x*-axis, the *y*-axis, or both axes to move to (−4, −3) on the coordinate plane?

Since the signs of both coordinates are different, point *J* would need to be reflected across _____.

Check your answer by reflecting (4, 3) across the *x*-axis only.

The coordinates of that reflected point are (4, ____).

Plot that point on the grid above and label it point *K*.

Now, reflect point *K* across the *y*-axis.

The coordinates of that reflected point are (_____, _____).

Plot that point above and label it point *L*.

Point *L* is at (_____, _____). Both of its coordinates have different signs than the coordinates of point *J*. Point *L* is a reflection of point *J* across _____.