

Lesson 19: Problem-Solving and the Coordinate Plane

Classwork

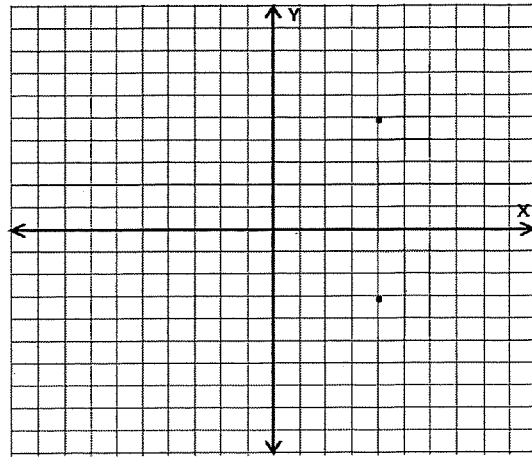
Opening Exercise

In the coordinate plane, find the distance between the points using absolute value.

$$(4, 5), (4, -3)$$

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

$$5 + 3 = 8 \text{ units.}$$



Exploratory Challenge

1. Locate and label $(4, 5)$ and $(4, -3)$. Draw the line segment between the endpoints given on the coordinate plane. How long is the line segment that you drew? Explain.

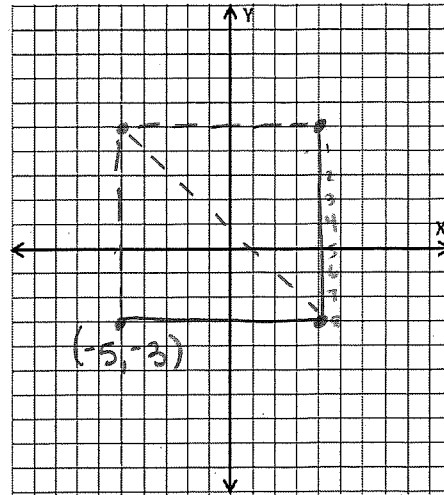
$$|5| = 5 \quad |-3| = 3$$

$$5 + 3 = 8 \text{ units.}$$

The total distance is 8 units.

2. Draw a horizontal line segment starting at $(4, -3)$ that has a length of 9 units. What are the possible coordinates of the other endpoint of the line segment? (There is more than one answer.)

$$(-5, -3) \text{ or } (13, -3)$$



Which point did you choose to be the other endpoint of the horizontal line segment? Explain how and why you chose that point. Locate and label the point on the coordinate grid.

The other end point of the horizontal line segment is $(-5, -3)$. I chose this point because the other option, $(13, -3)$ is located off of the coordinate grid.

3. The two line segments that you have just drawn could be seen as two sides of a rectangle. Given this, the endpoints of the two line segments would be three of the vertices of this rectangle.

- a. Find the coordinates of the fourth vertex of the rectangle. Explain how you find the coordinates of the fourth vertex using absolute value. The fourth vertex is $(-5, 5)$. The opposite sides of a rectangle are the same length. (This has to be 8 units long.) Also, the side from $(-5, -3)$ to the remaining vertex is a vertical line, so the endpoints must have the same first coordinate.

$|-3| = 3$ $8 - 3 = 5$, so the remaining vertex must be 5 units from x axis.

- b. How does the fourth vertex that you found relate to each of the consecutive vertices in either direction? Explain.

The fourth vertex has the same first coordinate as $(-5, -3)$ because they are the end points of a vertical line segment. The fourth vertex has the same second coordinate as $(4, 5)$ since they are the end points of a horizontal line segment.

- c. Draw the remaining sides of the rectangle.

4. Using the vertices that you have found and the lengths of the line segments between them, find the perimeter of the rectangle.

$8 + 9 + 8 + 9 = 34$; The perimeter of the rectangle is 34 units.

5. Find the area of the rectangle.

$9 \times 8 = 72$; the area of the rectangle is 72 units².

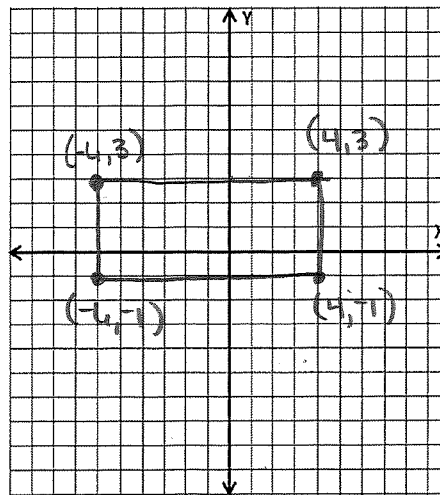
6. Draw a diagonal line segment through the rectangle with opposite vertices for endpoints. What geometric figures are formed by this line segment? What are the areas of each of these figures? Explain.

The diagonal line segment cuts the rectangle into two right triangles. The area of the triangles are 36 units² each because the triangles each make up half of the rectangle, and half of 72 is 36.

X Extension: Line the edge of a piece of paper up to the diagonal in the rectangle. Mark the length of the diagonal on the edge of the paper. Align your marks horizontally or vertically on the grid and estimate the length of the diagonal to the nearest integer. Use that estimation to now estimate the perimeter of the triangles.

7. Construct a rectangle on the coordinate plane that satisfies each of the criteria listed below. Identify the coordinate of each of its vertices.

- Each of the vertices lies in a different quadrant.
- Its sides are either vertical or horizontal.
- The perimeter of the rectangle is 28 units.



Using absolute value, show how the lengths of the sides of your rectangle provide a perimeter of 28 units.

$|-4| = 4$ $|4| = 4$ $4 + 4 = 8$, so the width of my rectangle is 8 units.

$|3| = 3$ $|-1| = 1$ $3 + 1 = 4$, so the height of my rectangle is 4 units.

$8 + 4 + 8 + 4 = 24$, so the perimeter of my rectangle is 24 units.