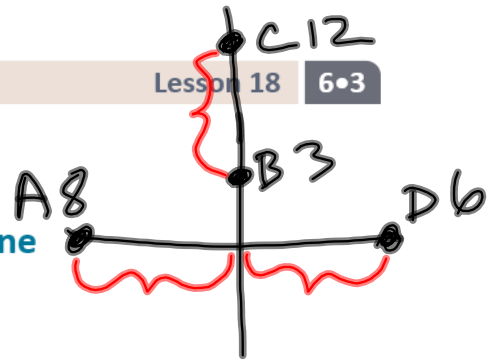## Lesson 18: Distance on the Coordinate Plane

Classwork

Opening Exercise

Four friends are touring on motorcycles. They come to an intersection of two roads; the road they are on continues straight, and the other is perpendicular to it. The sign at the intersection shows the distances to several towns. Draw a map/diagram of the roads and use it and the information on the sign to answer the following questions:

> Albertsville ← 8 mi
>
> Blossville ↑ 3 mi
>
> Cheyenne ↑ 12 mi
>
> Dewey Falls → 6 mi

What is the distance between Albertsville and Dewey Falls?

$$8 + 6 = 14 \text{ miles}$$

What is the distance between Blossville and Cheyenne?

$$12 - 3 = 9 \text{ miles}$$

On the coordinate plane, what represents the intersection of the two roads?

$$\text{Origin } (0,0)$$

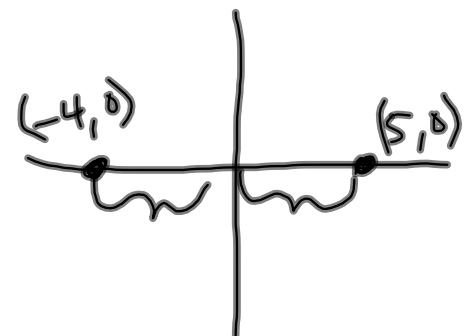**Example 1: The Distance Between Points on an Axis**

What is the distance between $(-4,0)$ and $(5,0)$?

What do the ordered pairs have in common and what does that mean about their location in the coordinate plane?

$$y\text{-coordinates are the same}$$

How did we find the distance between two numbers on the number line?
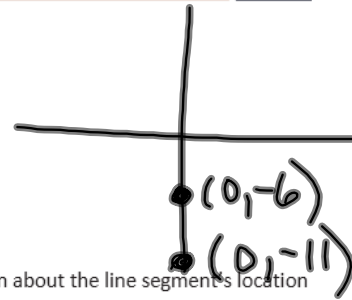
$$\text{add} \quad \text{absolute values}$$

Use the same method to find the distance between $(-4,0)$ and $(5,0)$.

$$|-4| + |5| = 4 + 5 = 9$$

Example 2: The Length of a Line Segment on an Axis

What is the length of the line segment with endpoints $(0, -6)$ and $(0, -11)$?

$(0, -6)$
$(0, -11)$

What do the ordered pairs of the endpoints have in common and what does that mean about the line segment's location in the coordinate plane?

x-coordinates are the same

Find the length of the line segment described by finding the distance between its endpoints $(0, -6)$ and $(0, -11)$.

$$|-11| - |-6| = 11 - 6 = 5 \text{ units}$$

Example 3: Length of a Horizontal or Vertical Line Segment that does Not Lie on an Axis

Find the length of the line segment with endpoints $(-3, 3)$ and $(-3, -5)$.

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

What do the endpoints, which are represented by the ordered pairs, have in common? What does that tell us about the location of the line segment on the coordinate plane?

x-coordinates are both -3.

Find the length of the line segment by finding the distance between its endpoints.
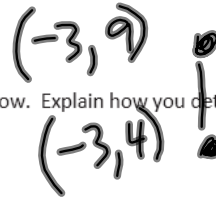
$$|3| + |-5| = 3 + 5 = 8 \text{ units}$$

Exercises

1. Find the lengths of the line segments whose endpoints are given below. Explain how you determined that the line segments are horizontal or vertical.
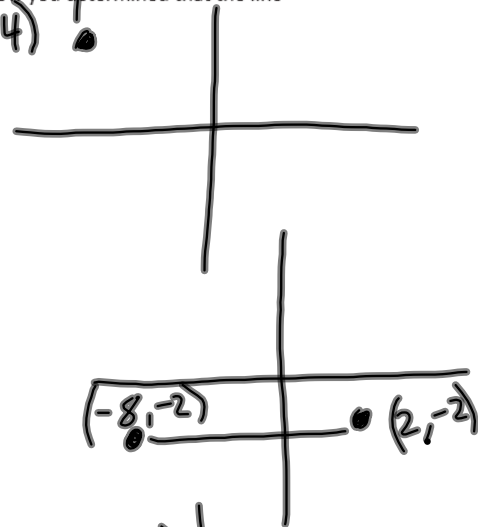
    a. $(-3, 4)$ and $(-3, 9)$
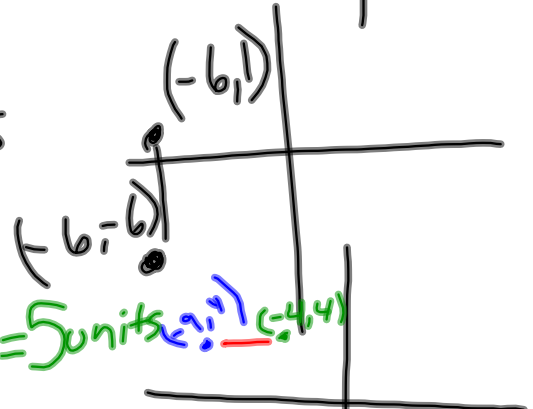
$$|9| - |4| = 9 - 4 = 5 \text{ units}$$

$(-3, 9)$
$(-3, 4)$

    b. $(2, -2)$ and $(-8, -2)$
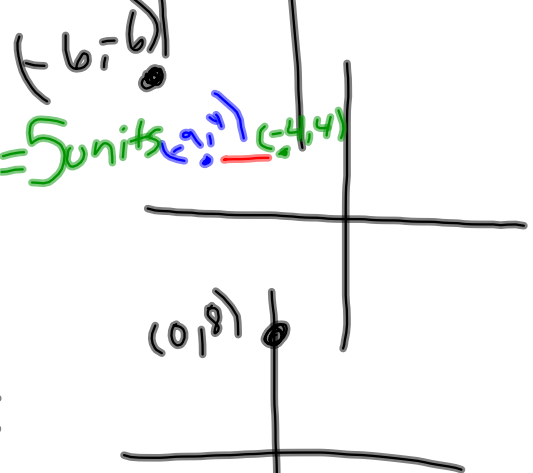
$$|-8| + |2| = 8 + 2 = 10 \text{ units}$$

$(-8, -2)$ $(2, -2)$

    c. $(-6, -6)$ and $(-6, 1)$

$$|-6| + |1| = 6 + 1 = 7 \text{ units}$$
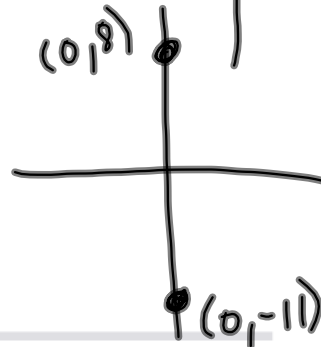
$(-6, 1)$
$(-6, -6)$

    d. $(-9, 4)$ and $(-4, 4)$

$$|-9| - |-4| = 9 - 4 = 5 \text{ units} (-9, 4) (-4, 4)$$

    e. $(0, -11)$ and $(0, 8)$

$$|-11| + |8| = 11 + 8 = 19 \text{ units}$$

$(0, 8)$

$(0, -11)$

Lesson Summary

To find the distance between points that lie on the same horizontal line or on the same vertical line, we can use the same strategy that we used to find the distance between points on the number line.

Problem Set

1. Find the length of the line segment with endpoints (7,2) and (−4,2), and explain how you arrived at your solution.

2. Sarah and Jamal were learning partners in math class and were working independently. They each started at the point (−2, 5) and moved 3 units vertically in the plane. Each student arrived at a different endpoint. How is this possible? Explain and list the two different endpoints.

3. The length of a line segment is 13 units. One endpoint of the line segment is (−3,7). Find four points that could be the other endpoints of the line segment.

① (−4,2) ____ (7,2)

$|-4| + |7| = 4 + 7 = 11$ units

② (−2,8)
↑ +3
(−2,5) • +3
↓ (−2,2)

③ (−3,7) +13

$\begin{pmatrix} -3, 20 \end{pmatrix}$
$\begin{pmatrix} -3, -6 \end{pmatrix}$
$\begin{pmatrix} -16, 7 \end{pmatrix}$
$\begin{pmatrix} 10, 7 \end{pmatrix}$