The Distance and Midpoint Formulas

Sometimes it is necessary to study line segments on the coordinate plane. A **line segment**, or a part of a line, contains two endpoints. The coordinates of these endpoints can help us find the length and the **midpoint**, or the point that is halfway between the two endpoints, of the line segment. We can calculate the length of a line segment by using the **Distance Formula**, and we can calculate the midpoint of a line segment by using the **Midpoint Formula**.

### The Distance Formula

To calculate the distance \( d \) of a line segment with endpoints \((x_1, y_1)\) and \((x_2, y_2)\) use the formula

\[
d = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}.
\]

### The Midpoint Formula

To calculate the midpoint of a line segment with endpoints \((x_1, y_1)\) and \((x_2, y_2)\) use the formula

\[
\left( \frac{x_1 + x_2}{2}, \frac{y_1 + y_2}{2} \right).
\]

### Examples

**a. Find the distance between (2, 3) and (6, 8).**

Let \( x_1 = 2, x_2 = 6, y_1 = 3, \) and \( y_2 = 8 \).

\[
d = \sqrt{(6 - 2)^2 + (8 - 3)^2} = \sqrt{16 + 25} = \sqrt{41} \text{ or } 6.4 \text{ units}
\]

**b. Find the midpoint of (5, 1) and (-1, 5).**

Let \( x_1 = 5, x_2 = -1, y_1 = 1, \) and \( y_1 = 5 \).

\[
\left( \frac{5 - 1}{2}, \frac{1 + 5}{2} \right) = \left( \frac{4}{2}, \frac{6}{2} \right) = (2, 3)
\]

*(2, 3) is the midpoint*

### Practice

**Find the distance between each pair of points. Round answers to the nearest hundredth.**

1. (4, 6), (1, 5)  
2. (15, 4), (10, 10)  
3. (-7, -2), (11, 3)  
4. (7, -5), (9, -1)  
5. (-8, 4), (3, -4)  
6. (-1.8, 1.9), (1.1, 2.8)  
7. **Standardized Test Practice**  
   What is the midpoint of the line segment with endpoints \((5, -1)\) and \((-9, 7)\)?
   A (2, -3)  
   B (-2, 3)  
   C (3, -2)  
   D (-3, 2)