

Find AB Given A (5, -3) And B(-11, -5).

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When working with points in a coordinate plane, one of the fundamental tasks is to determine the distance between two points. This process involves understanding the coordinates of the points and applying the distance formula derived from the Pythagorean theorem. In this article, we will explore in detail how to find the length of the segment AB, given the coordinates of points A and B, specifically A(5, -3) and B(-11, -5). We will break down the process step by step, discuss the relevant formulas, and provide examples to clarify the method.

Understanding the Coordinates of Points A and B

Coordinates of Point A

- Point A is located at (5, -3)
- The x-coordinate of A is 5
- The y-coordinate of A is -3

Coordinates of Point B

- Point B is located at (-11, -5)
- The x-coordinate of B is -11
- The y-coordinate of B is -5

Understanding these coordinates is essential because the distance formula relies on the differences in the x-coordinates and y-coordinates of the two points.

The Distance Formula

Derivation of the Distance Formula

The distance between two points $A(x_1, y_1)$ and $B(x_2, y_2)$ can be thought of as the hypotenuse of a right-angled triangle formed by the differences in their x and y coordinates. According to the Pythagorean theorem:

$$AB = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$$

This formula calculates the straight-line distance between the points in the coordinate plane.

Applying the Formula

To find AB , substitute the coordinates of points A and B into the formula:

$$AB = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$$

Where:

- $(x_1 = 5)$, $(y_1 = -3)$
- $(x_2 = -11)$, $(y_2 = -5)$

So, the specific calculation becomes:

$$AB = \sqrt{(-11 - 5)^2 + (-5 - (-3))^2}$$

Now, let's proceed step by step.

Calculating the Distance Step by Step

Step 1: Find the difference in x-coordinates

$$x_2 - x_1 = -11 - 5 = -16$$

Step 2: Find the difference in y-coordinates

$$\begin{aligned} & y_2 - y_1 = -5 - (-3) = -5 + 3 = -2 \end{aligned}$$

Step 3: Square the differences

$$\begin{aligned} & (-16)^2 = 256 \\ & (-2)^2 = 4 \end{aligned}$$

Step 4: Sum the squared differences

$$256 + 4 = 260$$

Step 5: Take the square root to find the distance

$$AB = \sqrt{260}$$

Final Calculation and Result

Simplifying the Square Root

The square root of 260 can be simplified by factoring out perfect squares:

$$\sqrt{260} = \sqrt{4 \times 65} = \sqrt{4} \times \sqrt{65} = 2 \sqrt{65}$$

Therefore, the exact length of AB is:

$$AB = 2 \sqrt{65}$$

If a decimal approximation is desired, we evaluate $(\sqrt{65})$:

$\sqrt{65} \approx 8.062$

So,

$AB \approx 2 \times 8.062 = 16.124$

Result: The length of segment AB is approximately 16.124 units.

Additional Considerations

Using a Calculator

For quick approximate results, a calculator can be used to compute $\sqrt{260}$ directly, which yields approximately 16.124.

Understanding the Significance

Knowing how to find the distance between two points is fundamental in geometry, navigation, and many applied fields such as physics, engineering, and computer graphics.

Summary of the Process

To summarize, the key steps to find the length AB given points A and B are:

1. Identify the coordinates of A and B.
2. Calculate the differences in the x-coordinates and y-coordinates.
3. Square these differences.
4. Sum the squared differences.
5. Take the square root of the sum to get the distance.

This systematic approach ensures accuracy and clarity in solving problems involving distances in the coordinate plane.

Practice Problems

Try These on Your Own

1. Find the distance between C(2, 4) and D(10, -2).
2. Determine the length of segment EF, given E(-3, 7) and F(4, 1).
3. Calculate the distance between points G(0, 0) and H(5, 12).

Answers:

1. $\sqrt{(10 - 2)^2 + (-2 - 4)^2} = \sqrt{8^2 + (-6)^2} = \sqrt{64 + 36} = \sqrt{100} = 10$
2. $\sqrt{(4 - (-3))^2 + (1 - 7)^2} = \sqrt{7^2 + (-6)^2} = \sqrt{49 + 36} = \sqrt{85} \approx 9.22$
3. $\sqrt{(5 - 0)^2 + (12 - 0)^2} = \sqrt{25 + 144} = \sqrt{169} = 13$

Conclusion

Finding the distance between two points in a coordinate plane is a fundamental skill in geometry that combines understanding of coordinate systems with the application of the Pythagorean theorem. By carefully substituting the points' coordinates into the distance formula, performing the necessary calculations step by step, and simplifying the result, you can accurately determine the length of the segment connecting any two points. Whether working with the exact radical form or a decimal approximation, this method provides a clear and reliable way to approach such problems.

Frequently Asked Questions

How do I find the length of segment AB given points A(5, -3) and B(-11, -5)?

Use the distance formula: $\sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$. Plugging in the points: $\sqrt{(-11 - 5)^2 + (-5 - (-3))^2} = \sqrt{(-16)^2 + (-2)^2} = \sqrt{256 + 4} = \sqrt{260} \approx 16.12$.

What is the formula to find the midpoint of segment AB with given coordinates?

Midpoint M = $((x_1 + x_2)/2, (y_1 + y_2)/2)$. For A(5, -3) and B(-11, -5), midpoint M = $((5 + (-11))/2, (-3 + (-5))/2) = (-3, -4)$.

How can I find the slope of line AB given points A(5, -3) and B(-11, -5)?

Slope $m = (y_2 - y_1) / (x_2 - x_1)$. So, $m = (-5 - (-3)) / (-11 - 5) = (-2) / (-16) = 1/8$.

What is the significance of the given points A(5, -3) and B(-11, -5) in coordinate geometry?

They define a specific line segment in the coordinate plane, and can be used to find various properties like length, midpoint, slope, and equation of the line passing through them.

How do I write the equation of line AB passing through points A(5, -3) and B(-11, -5)?

First, find the slope $m = 1/8$. Then, use point-slope form: $y - y_1 = m(x - x_1)$. Using point A(5, -3): $y + 3 = (1/8)(x - 5)$. Simplify to get the line's equation: $y = (1/8)(x - 5) - 3$.

Can I find the vector representation of segment AB with points A(5, -3) and B(-11, -5)?

Yes. Vector $AB = B - A = (-11 - 5, -5 - (-3)) = (-16, -2)$. This vector indicates the direction and magnitude from A to B.

What is the importance of understanding how to find AB given points A and B?

It helps in various geometric calculations such as measuring distances, finding midpoints, analyzing slopes, and understanding the position of points relative to each other in the coordinate plane.

Additional Resources

Find AB Given A (5, -3) and B (-11, -5)

In the realm of coordinate geometry, the ability to determine the length of a segment between two points lies at the core of many mathematical applications, from simple classroom exercises to complex engineering designs. When tasked with finding the length of the segment AB, given points A and B with specific coordinates, the process involves applying the distance formula—a fundamental principle derived from the Pythagorean theorem. This article offers an in-depth exploration of how to compute the length of segment AB, examining the mathematical foundations, step-by-step procedures, and broader implications of such calculations.

Understanding the Coordinates and the Distance Formula

Coordinates of Points A and B

The problem provides two points on the Cartesian plane:

- Point A with coordinates (5, -3)
- Point B with coordinates (-11, -5)

These points are located in a two-dimensional space, where the first value in each pair represents the x-coordinate (horizontal position), and the second value indicates the y-coordinate (vertical position). Analyzing these coordinates helps visualize the points' placement relative to each other and the axes.

The Distance Formula: An Overview

To find the length of segment AB, we rely on the distance formula, which is derived from the Pythagorean theorem. The formula calculates the straight-line distance between any two points (x_1, y_1) and (x_2, y_2) :

$$\text{Distance} = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$$

This formula essentially measures the hypotenuse of a right-angled triangle formed by the horizontal and vertical differences between the points.

Step-by-Step Calculation of AB

Step 1: Identify the Coordinates

- A: $(x_1, y_1) = (5, -3)$
- B: $(x_2, y_2) = (-11, -5)$

Step 2: Calculate the Differences in Coordinates

- Horizontal difference: $\Delta x = x_2 - x_1 = -11 - 5 = -16$
- Vertical difference: $\Delta y = y_2 - y_1 = -5 - (-3) = -5 + 3 = -2$

Note: The signs indicate direction, but since we are interested in distance (a scalar quantity), we will square these differences, rendering any negative signs irrelevant to the final magnitude.

Step 3: Square the Differences

- $(\Delta x)^2 = (-16)^2 = 256$
- $(\Delta y)^2 = (-2)^2 = 4$

Step 4: Sum the Squares

- Sum: $256 + 4 = 260$

Step 5: Take the Square Root

- Distance $AB = \sqrt{260}$

Since 260 is not a perfect square, express the radical in simplified radical form:

- $\sqrt{260} = \sqrt{4 \times 65} = \sqrt{4} \times \sqrt{65} = 2\sqrt{65}$

Final Answer:

$$AB = 2\sqrt{65}$$

Numerically approximated:

$$AB \approx 2 \times 8.062 = 16.124$$

Thus, the length of segment AB is approximately 16.124 units.

Deeper Insights and Applications

Implications of the Distance Calculation

Determining the length of segments between points is foundational in various fields:

- Geometry and Trigonometry: Helps in understanding shapes, angles, and spatial relationships.
- Physics: Used in calculating distances traveled, displacement, and vectors.
- Engineering and Design: Essential for constructing accurate models, ensuring measurements are precise.
- Computer Graphics: Critical in rendering objects and calculating distances for collision detection.

Extension to Coordinate Geometry Problems

Beyond just calculating the segment length, the same principles underpin more complex analytical tasks:

- Finding midpoints: $\left(\frac{x_1 + x_2}{2}, \frac{y_1 + y_2}{2} \right)$
- Equation of the line passing through two points
- Determining slopes and angles between segments
- Analyzing geometric transformations such as translations, rotations, and reflections

Additional Considerations in Distance Calculations

Handling Negative Coordinates

The example points include negative coordinates, which are common in coordinate geometry. The process remains unchanged because squaring negates the sign, but visualization requires understanding that negative coordinates lie in the quadrants of the Cartesian plane:

- Quadrant II: $(x < 0, y > 0)$
- Quadrant III: $(x < 0, y < 0)$
- Quadrant IV: $(x > 0, y < 0)$

Understanding the quadrants helps in visualizing the relative positions of points and verifying calculations.

Precision and Approximation

While radical forms provide exact distances, practical applications often require decimal approximations. Calculators or computational tools can facilitate quick and accurate conversions, especially when dealing with more complex radical expressions.

Limitations and Assumptions

- The calculation assumes a flat, Euclidean plane without distortions.
- It presumes points are accurately located; measurement errors can affect results.
- The method applies to straight-line segments; curved or irregular paths require different approaches.

Conclusion: The Significance of Accurate Distance Measurement

The process of calculating the distance between two points, such as $A(5, -3)$ and $B(-11, -5)$, exemplifies a fundamental yet powerful technique in coordinate geometry. Through systematic application of the distance formula, we attain precise measurements essential in numerous scientific and engineering domains. The ability to interpret, visualize, and compute such distances not only enhances mathematical literacy but also underpins practical problem-solving in real-world contexts.

The example underscores the importance of understanding coordinate differences, algebraic manipulation, and radical simplification—all vital skills for students, educators, and professionals alike. As mathematical tools continue to evolve with technological advancements, mastery of these foundational concepts remains crucial in navigating complex spatial challenges and fostering innovation across disciplines.

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