

5) Find The Coordinates Of The Point That Is Of The Way From A To B. Given: A(-6, -7) And B(4, 9). (Show

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Understanding how to find a specific point along the line segment connecting two points is a fundamental concept in coordinate geometry. Whether you're working on a math assignment, solving a problem in physics, or developing a computer graphics application, knowing how to determine an intermediate point between two coordinates is essential. In this guide, we'll explore the process step by step, using the given points A(-6, -7) and B(4, 9), to find a point that lies a certain fraction along the way from A to B.

Introduction to Coordinate Geometry and Line Segments

What Is a Coordinate Plane?

The coordinate plane is a two-dimensional surface defined by two perpendicular axes:

- The x-axis (horizontal)
- The y-axis (vertical)

Every point on this plane is represented by an ordered pair (x, y), where:

- x indicates the horizontal position
- y indicates the vertical position

Understanding Points A and B

In our case:

- Point A is at coordinates (-6, -7)
- Point B is at coordinates (4, 9)

These points define a line segment connecting A and B.

The Concept of a Point "Of The Way"

When asked to find a point "of the way" from A to B, it usually refers to a point that divides the line segment in a particular ratio or fraction:

- For example, the point that is halfway between A and B.

- Or a point that is one-third of the way from A to B.

Understanding the Concept of Division of a Line Segment

What Is a Dividing Point?

A dividing point is a point on the line segment between two points that divides the segment into parts based on a specific ratio or fraction.

Types of Divisions

- Midpoint: Exactly halfway between A and B.
- Point dividing the segment in ratio m:n: A point that divides the segment into two parts such that the ratio of the lengths is m to n.
- Point at a specific fraction: For example, $\frac{1}{3}$ or $\frac{3}{4}$ along the way from A to B.

Mathematical Approach to Finding a Point "Of The Way"

Using the Section Formula

The section formula allows us to find a point dividing the segment between two points in a given ratio. If a point P divides the segment AB in the ratio m:n, then the coordinates of P are given by:

$$P(x, y) = \left(\frac{mx_2 + nx_1}{m + n}, \frac{my_2 + ny_1}{m + n} \right)$$

Where:

- $A(x_1, y_1)$
- $B(x_2, y_2)$

Finding a Point at a Fraction Along the Line

If the point is t fraction of the way from A to B, then the ratios are related as:

\[

$$t = \frac{\text{distance from A to P}}{\text{distance from A to B}}$$

The coordinates of this point P can be calculated using the concept of linear interpolation:

$$P = A + t (B - A)$$

Where:

- $A = (x_1, y_1)$
- $B = (x_2, y_2)$
- t is the fraction (e.g., 0.25 for 25%)

Expressed component-wise:

$$x_P = x_1 + t (x_2 - x_1)$$

$$y_P = y_1 + t (y_2 - y_1)$$

Applying the Method to Given Points A(-6, -7) and B(4, 9)

Step 1: Determine the Fraction t

Suppose we're asked to find the point that is of the way from A to B, in terms of a specific fraction t . For this example, let's find the point that is halfway ($t = 0.5$), a common case.

Step 2: Calculate the Coordinates

Using the interpolation formulas:

$$x_P = x_1 + t (x_2 - x_1) = -6 + 0.5 (4 - (-6)) = -6 + 0.5 (10) = -6 + 5 = -1$$

$$y_P = y_1 + t (y_2 - y_1) = -7 + 0.5 (9 - (-7)) = -7 + 0.5 (16) = -7 + 8 = 1$$

Result: The point halfway between A and B is at (-1, 1).

Step 3: Generalize for Any Fraction t

If you need to find a point at any other fraction, simply substitute the value of t into the formulas:

$$\begin{aligned} & \backslash \\ x_P &= -6 + t(10) \\ & \backslash \\ & \backslash \\ y_P &= -7 + t(16) \\ & \backslash \end{aligned}$$

Some common fractions:

- 1/4 (quarter point):

$$\begin{aligned} & \backslash \\ x_P &= -6 + 0.25(10) = -6 + 2.5 = -3.5 \\ & \backslash \\ & \backslash \\ y_P &= -7 + 0.25(16) = -7 + 4 = -3 \\ & \backslash \end{aligned}$$

- 3/4 (three-quarters point):

$$\begin{aligned} & \backslash \\ x_P &= -6 + 0.75(10) = -6 + 7.5 = 1.5 \\ & \backslash \\ & \backslash \\ y_P &= -7 + 0.75(16) = -7 + 12 = 5 \\ & \backslash \end{aligned}$$

Visualizing the Point on the Coordinate Plane

Plotting Points A and B

- Point A: (-6, -7)
- Point B: (4, 9)

Plot these points on the coordinate plane for visual understanding.

Plotting the Intermediate Point

- For t=0.5: (-1, 1)

This point lies exactly midway, visually confirming that it's equidistant from A and B.

Real-World Applications of Finding a Point "Of The Way"

Physics and Engineering

- Calculating the position of an object moving along a straight path.
- Determining the midpoint for structural analysis or balancing.

Computer Graphics

- Interpolating colors, positions, or animations.
- Creating smooth transitions between two points.

Navigation and Mapping

- Calculating a point along a route or path.
- Dividing a journey into equal segments.

Summary and Key Takeaways

- The section formula helps find a point dividing a segment in a given ratio or fraction.
- Linear interpolation is used to find any point "of the way" between two coordinates.
- For points A(-6, -7) and B(4, 9), the midpoint is at (-1, 1).
- Adjusting the value of t allows you to find points at any fractional distance along the segment.
- This concept has practical applications across various fields, including physics, computer graphics, and navigation.

Conclusion

Calculating the point that lies a certain fraction along the line segment connecting two points is a straightforward process once you understand the underlying formulas. By using linear interpolation or the section formula, you can accurately determine any such point, providing valuable insights in both academic and practical contexts. Given points A(-6, -7) and B(4, 9), the midpoint is at (-1, 1), serving as a perfect example of this technique. Whether for solving math problems or real-world applications, mastering this method enhances your understanding of coordinate geometry and its versatile uses.

Note: If you have a specific fraction t in mind other than 0.5, simply substitute that value into the formulas:

$$\begin{aligned} x_P &= x_1 + t(x_2 - x_1) \\ y_P &= y_1 + t(y_2 - y_1) \end{aligned}$$

and compute accordingly.

Frequently Asked Questions

What is the first step to find the point that divides the segment from A to B in a given ratio?

The first step is to identify the ratio in which the point divides the segment, then use the section formula to find its coordinates.

How do you apply the section formula to find the point dividing segment AB in a given ratio?

The section formula states that if a point divides the segment joining A(x_1 , y_1) and B(x_2 , y_2) in the ratio $m:n$, then the coordinates are $((mx_2 + nx_1) / (m + n), (my_2 + ny_1) / (m + n))$.

Given points A(-6, -7) and B(4, 9), how do you find the midpoint between A and B?

For the midpoint, the ratio is 1:1. The coordinates are $((-6 + 4)/2, (-7 + 9)/2) = (-1, 1)$.

What is the significance of knowing the ratio in which the point divides segment AB?

Knowing the ratio allows you to accurately compute the exact coordinates of the dividing point using the section formula, which generalizes beyond just midpoints.

Can the section formula be used to find the point that is a specific fraction along the way from A to B?

Yes, by setting the ratio $m:n$ to correspond to the fractional distance along the segment, the section formula gives the exact point at that fraction.

How do you interpret the coordinates of the point that divides segment AB in a certain ratio?

The coordinates represent the precise location of the point relative to A and B, proportionally dividing the segment according to the given ratio.

Additional Resources

Find the Coordinates of the Point That Is a Given Fraction of the Way From A to B: A Step-by-Step Guide

When working with coordinate geometry, a common problem involves finding a specific point that lies along the line segment connecting two given points, A and B. Whether you're designing a graphic, analyzing a geometric shape, or solving a math problem, understanding how to find the coordinates of the point that is a certain fraction of the way from A to B is an essential skill. In this guide, we will explore this concept using the specific points A(-6, -7) and B(4, 9), and demonstrate how to determine the point that lies, for example, halfway between them, or at any other fractional distance.

Understanding the Concept

Before diving into calculations, it's important to grasp what it means to find a point that is a certain fraction of the way along the line segment from A to B.

Suppose you have:

- Point A at coordinates $((x_1, y_1))$
- Point B at coordinates $((x_2, y_2))$

And you want to find the point (P) such that:

- (P) is t fraction of the way from A to B, where (t) is a real number between 0 and 1.

What does (t) represent?

- When $(t=0)$, (P) coincides with A.
- When $(t=1)$, (P) coincides with B.
- When $(t=0.5)$, (P) is exactly in the middle (the midpoint).
- For other values of (t) , (P) lies somewhere along the segment, closer to A or B depending on the value.

The Formula for the Coordinates of the Point

The coordinates of point (P) that divides the segment (AB) in the ratio $(t:(1-t))$ are given by:

$$\boxed{P = \left(x_1 + t(x_2 - x_1), y_1 + t(y_2 - y_1) \right)}$$

This formula is derived from the concept of vector addition and linear interpolation between the two points.

Applying the Formula to Our Points: A(-6, -7) and B(4, 9)

Given:

- $(A(-6, -7))$
- $(B(4, 9))$

Suppose we want to find the point (P) that is a certain fraction (t) of the way from A to B.

Step 1: Choose the Fraction (t)

The value of (t) depends on the problem:

- For the midpoint: $(t=0.5)$
- For a point one-third of the way: $(t=1/3)$
- For a point three-quarters of the way: $(t=0.75)$

Let's explore several cases.

Case 1: Finding the Midpoint $(t=0.5)$

The midpoint is the most common special case where $(t=0.5)$. It divides the segment into two equal parts.

Calculation:

$$x = -6 + 0.5 \times (4 - (-6)) = -6 + 0.5 \times 10 = -6 + 5 = -1$$

$$y = -7 + 0.5 \times (9 - (-7)) = -7 + 0.5 \times 16 = -7 + 8 = 1$$

Result:

The midpoint (P) has coordinates $(-1, 1)$.

Case 2: Finding a Point One-Third of the Way ($t=1/3$)

Calculation:

$$x = -6 + \frac{1}{3} \times (4 - (-6)) = -6 + \frac{1}{3} \times 10 = -6 + \frac{10}{3} \approx -6 + 3.33 = -2.67$$

$$y = -7 + \frac{1}{3} \times (9 - (-7)) = -7 + \frac{1}{3} \times 16 = -7 + 5.33 \approx -1.67$$

Result:

Coordinates are approximately $(-2.67, -1.67)$.

Case 3: Finding a Point Three-Quarters of the Way ($t=0.75$)

Calculation:

$$x = -6 + 0.75 \times 10 = -6 + 7.5 = 1.5$$

$$y = -7 + 0.75 \times 16 = -7 + 12 = 5$$

Result:

Coordinates are $(1.5, 5)$.

Visualizing the Process

To better understand, picture the segment from A to B as a straight line. The parameter t tells us how far along this line the point P is.

- At $t=0$, we're at A.
- At $t=1$, we're at B.
- At $t=0.5$, we're at the midpoint.
- At any other t , P is proportionally located along the line segment.

This method is not only useful for finding specific points but also forms the backbone of more advanced topics like vector addition, parametric equations, and computer graphics.

Practical Applications

Understanding how to find points at fractional distances between two points has numerous applications:

- Graphics and Animation: Interpolating positions for smooth transitions.
- Engineering and Design: Creating division points in structural elements.
- Navigation and Mapping: Calculating intermediate waypoints.
- Mathematics and Education: Teaching concepts of ratios and interpolation.

Summary of the Step-By-Step Process

Here's a quick checklist to find the point a fraction t of the way from A to B:

1. Identify the points:
 - $A(x_1, y_1)$
 - $B(x_2, y_2)$
2. Decide the fraction t : (e.g., 0.5 for midpoint)
3. Calculate the differences:
 - $\Delta x = x_2 - x_1$
 - $\Delta y = y_2 - y_1$
4. Apply the formula:
 - $x_P = x_1 + t \times \Delta x$
 - $y_P = y_1 + t \times \Delta y$
5. Interpret your result.

Final Thoughts

Mastering how to find the point that is a specific fraction along the way from one point to another is a foundational skill in coordinate geometry. By understanding and applying the linear interpolation formula, you can seamlessly determine any such point, whether halfway, one-third, or any other fraction along the segment. With practice, these calculations become intuitive, empowering you to

solve a wide range of geometric and real-world problems efficiently.

Remember: Always verify your calculations with a visual sketch when possible — it can provide valuable intuition and catch potential errors. Happy geometrizing!

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