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Understanding how to analyze points on a coordinate grid is fundamental in geometry, especially when dealing with lines, distances, and slopes. In this article, we will explore how to determine various properties related to two points on a grid, specifically focusing on the points A(0, 3) and B(6, 6). Our goal is to work through the problem step-by-step to find the missing information, which typically involves calculating the coordinates of the points, the length of the line segment AB, and the slope of the line connecting them.

Introduction to Coordinates and the Coordinate Plane

Before diving into calculations, it’s essential to understand the basics of the coordinate plane.

What Are Coordinates?

Coordinates are pairs of numbers that specify the position of a point in a two-dimensional space. They are written as (x, y), where:
- x represents the horizontal position (left to right).
- y represents the vertical position (up and down).

For example, the point A(0, 3) is located at:
- 0 units along the x-axis.
- 3 units along the y-axis.

Similarly, B(6, 6) is situated at:
- 6 units along the x-axis.
- 6 units along the y-axis.

The Coordinate Grid

The coordinate grid consists of two perpendicular axes:
- The x-axis (horizontal).

- The y-axis (vertical).

Points are plotted based on their x and y values, and the grid helps visualize relationships like distances, slopes, and midpoints.

Finding the Length of Line Segment AB

One of the primary tasks is to determine the length of the line segment connecting points A and B. This is achieved using the distance formula derived from the Pythagorean theorem.

The Distance Formula

Given two points, A(x_1, y_1) and B(x_2, y_2), the distance (d) between them is:

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

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

Calculating the Distance Between A and B

Substituting the given coordinates:
- A(0, 3)
- B(6, 6)

We get:
$$ d = \sqrt{(6 - 0)^2 + (6 - 3)^2} $$
$$ d = \sqrt{(6)^2 + (3)^2} $$
$$ d = \sqrt{36 + 9} $$
$$ d = \sqrt{45} $$
$$ d = \sqrt{9 \times 5} $$
$$ d = 3\sqrt{5} $$

Therefore, the length of segment AB is $3\sqrt{5}$ units.

Calculating the Slope of Line AB

The slope of a line indicates its steepness and the direction it travels across the grid.

What Is the Slope?

The slope (m) between two points is given by:

$$ m = \frac{y_2 - y_1}{x_2 - x_1} $$

It measures the change in y over the change in x.

Calculating the Slope Between A and B

Plugging in the given points:
$$ m = \frac{6 - 3}{6 - 0} $$
$$ m = \frac{3}{6} $$
$$ m = \frac{1}{2} $$

Hence, the slope of line AB is $\frac{1}{2}$.

This positive slope indicates that the line rises as it moves from left to right at a rate of 1 unit vertically for every 2 units horizontally.

Finding the Equation of Line AB

Knowing the slope and one point on the line allows us to write its equation in slope-intercept form.

Using Point-Slope Form

The point-slope form of a line is:

$$ y - y_1 = m(x - x_1) $$

Using point A(0, 3) and slope $\frac{1}{2}$:

$$ y - 3 = \frac{1}{2}(x - 0) $$
$$ y - 3 = \frac{1}{2}x $$
$$ y = \frac{1}{2}x + 3 $$

The equation of line AB is: $y = \frac{1}{2}x + 3$.

Additional Properties and Applications

Understanding the properties of this line and the points helps in various geometric applications.

Midpoint of Segment AB

The midpoint is the point exactly halfway between A and B, calculated as:

$$ M = \left(\frac{x_1 + x_2}{2}, \frac{y_1 + y_2}{2} \right) $$

Applying the coordinates:

$$ M = \left(\frac{0 + 6}{2}, \frac{3 + 6}{2} \right) $$
$$ M = (3, 4.5) $$

Therefore, the midpoint of segment AB is (3, 4.5).

Parallel and Perpendicular Lines

- Lines parallel to AB will have the same slope $ \frac{1}{2} $.
- Lines perpendicular to AB will have a slope of $ -2 $ (the negative reciprocal).

Summary of Key Calculations

Property	Calculation	Result
Distance	$ \sqrt{(6-0)^2 + (6-3)^2} $	$ 3\sqrt{5} $ units
Slope	$ \frac{6-3}{6-0} $	$ \frac{1}{2} $
Equation of Line	$ y = \frac{1}{2}x + 3 $	Slope-intercept form
Midpoint	$ \left(\frac{0+6}{2}, \frac{3+6}{2} \right) $	(3, 4.5)

Conclusion

Analyzing points on a coordinate grid involves a combination of techniques including calculating distances, slopes, midpoints, and line equations. For the points A(0, 3) and B(6, 6), we determined that the length of the segment AB is $ 3\sqrt{5} $ units, and the line connecting them has a slope of $ \frac{1}{2} $. The equation of the line is $ y = \frac{1}{2}x + 3 $, and its midpoint is at (3, 4.5). These calculations are fundamental in geometry

and provide a foundation for more advanced topics such as coordinate geometry, vectors, and transformations.

If you want to deepen your understanding, consider exploring how these concepts extend to three-dimensional space, or how to find the equations of lines passing through given points with different slopes. Practice plotting points and lines on graph paper to visualize these concepts effectively!

Frequently Asked Questions

What are the coordinates of point A on the grid?

The coordinates of point A are (0, 3).

What are the coordinates of point B on the grid?

The coordinates of point B are (6, 6).

How do you find the slope of the line passing through points A and B?

The slope is calculated as (change in y) divided by (change in x): (6 - 3) / (6 - 0) = 3 / 6 = 0.5.

What is the equation of the line AB in slope-intercept form?

Using the slope 0.5 and point A (0, 3), the line's equation is y = 0.5x + 3.

How can you verify the coordinates of point B lie on the line AB?

Substitute x = 6 into y = 0.5x + 3: y = 0.5(6) + 3 = 3 + 3 = 6, which matches point B's y-coordinate, confirming B lies on the line.

What is the length of the line segment AB?

Using the distance formula: √[(6 - 0)^2 + (6 - 3)^2] = √[36 + 9] = √45 ≈ 6.71 units.

How is the midpoint of segment AB calculated?

The midpoint is ((0 + 6)/2, (3 + 6)/2) = (3, 4.5).

What is the significance of the coordinates (0, 3) and (6, 6) in the context of the line AB?

These coordinates represent the endpoints of line segment AB, which allows us to determine its slope, equation, length, and midpoint.

Additional Resources

Line AB and Its Coordinates: A Deep Dive into Geometric Analysis on the Grid

Understanding the properties of lines and points on a coordinate grid forms a cornerstone of basic geometry, serving as foundational knowledge for more advanced mathematical concepts. When a line is drawn on a coordinate plane, and specific points are marked along it, the process of determining unknown coordinates, slopes, and equations becomes both an analytical challenge and an insightful exercise. In this article, we explore the scenario where Line AB is depicted on a grid, with Point A at (0, 3) and Point B at (6, 6), aiming to determine the coordinates of a third point, A, which appears to be a typographical or contextual element that requires clarification. We will systematically analyze the problem, interpret the data, and derive meaningful conclusions about the line's properties, including its slope, equation, and the potential location of any associated points.

Understanding the Basic Data: Points and the Line

Points A and B: Coordinates and Significance

The initial data provided positions point A at (0, 3) and point B at (6, 6). These points are critical because:

- They serve as concrete references to understand the line's position on the grid.
- They enable the calculation of the line's slope, which describes its steepness and orientation.
- They assist in deriving the line's equation, an essential aspect for plotting or further analysis.

Point A (0, 3):
This point lies on the y-axis, 3 units above the origin, indicating that the line crosses the y-axis at $y=3$ when $x=0$.

Point B (6, 6):
Located six units along the x-axis and six units up on the y-axis, this point is useful for calculating the slope between the two points.

Calculating the Slope of Line AB

The Concept of Slope in Coordinate Geometry

The slope (m) of a line passing through two points (x_1, y_1) and (x_2, y_2) is given by the formula:

$$ m = \frac{y_2 - y_1}{x_2 - x_1} $$

This ratio indicates how much y changes with a change in x, effectively measuring the line's inclination.

Applying the Slope Formula to Points A and B

Given:
A (0, 3) → $(x_1, y_1) = (0, 3)$
B (6, 6) → $(x_2, y_2) = (6, 6)$

Calculating:
$$ m = \frac{6 - 3}{6 - 0} = \frac{3}{6} = \frac{1}{2} $$

Interpretation:
The line has a slope of 1/2, meaning for every 2 units it moves horizontally, it rises by 1 unit vertically. This moderate incline is characteristic of a line that steadily ascends, crossing the y-axis at y=3.

Deriving the Equation of Line AB

Using the Point-Slope Form

The point-slope form of a line's equation is:

$$ y - y_1 = m(x - x_1) $$

Choosing point A (0, 3) and slope m=1/2:

$$ y - 3 = \frac{1}{2}(x - 0) $$

Simplifies to:

$$ y - 3 = \frac{1}{2}x $$

Adding 3 to both sides:

$$ y = \frac{1}{2}x + 3 $$

Result:
The equation of line AB in slope-intercept form is:

$$ y = \frac{1}{2}x + 3 $$

This linear equation describes all points lying on the line passing through A and B.

Verification of the Equation

Check whether point B (6, 6) satisfies the equation:

$$ y = \frac{1}{2} \times 6 + 3 = 3 + 3 = 6 $$

Yes, it does. Confirming the consistency of the equation with the known points.

Interpreting the Query: "Work Out The Coordinates of"

The prompt suggests an incomplete phrase: "Work Out The Coordinates of". Given the context, this likely refers to:

- Finding the coordinates of a specific point on the line, perhaps a third point.
- Determining the position of a point related to line AB, such as the intersection with a given line, a midpoint, or a point of interest.

Since the initial data involves only points A and B, and the phrase specifies "Line AB Is Shown On The Grid. A Is The Point (0, 3) B Is The Point (6, 6)", the most logical interpretation is that we are asked to:

- Find the coordinates of a particular point on the line AB, such as the midpoint, a point at a specific x-value, or a point at a certain distance along the line.

Possible Objectives and Corresponding Calculations

Depending on the context, several specific calculations might be relevant. Let's explore some typical scenarios.

1. Finding a Midpoint of Line Segment AB

Midpoint formula:
$$ M = \left(\frac{x_1 + x_2}{2}, \frac{y_1 + y_2}{2} \right) $$

Applying to points A and B:

$$ M_x = \frac{0 + 6}{2} = 3 $$
$$ M_y = \frac{3 + 6}{2} = 4.5 $$

Midpoint:
$$ (3, 4.5) $$

This point lies exactly midway between A and B, useful for understanding the line's center or for segment division.

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2. Finding a Point at a Specific x-Value

Suppose we want to find the y-coordinate of the point on line AB when x=2:

Using the line equation:

$$ y = \frac{1}{2}x + 3 $$

Plugging in x=2:

$$ y = \frac{1}{2} \times 2 + 3 = 1 + 3 = 4 $$

Point at x=2:
$$ (2, 4) $$

Similarly, for x=4:

$$ y = \frac{1}{2} \times 4 + 3 = 2 + 3 = 5 $$

Point at x=4:
$$ (4, 5) $$

These points can be plotted to visualize the line more comprehensively.

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3. Finding a Point at a Given Distance from A or B

Suppose the question involves finding a point at a certain distance along the line from A or B. For example, find the point 2 units from A along the line.

Method:

- Determine the unit vector in the direction from A to B.
- Multiply this vector by the desired distance.
- Add the scaled vector to the starting point.

Step-by-step:

- Vector from A to B:

$$ \vec{AB} = (6 - 0, 6 - 3) = (6, 3) $$

- Length of AB:

$$ |\vec{AB}| = \sqrt{6^2 + 3^2} = \sqrt{36 + 9} = \sqrt{45} = 3\sqrt{5} $$

- Unit vector:

$$ \hat{u} = \left(\frac{6}{3\sqrt{5}}, \frac{3}{3\sqrt{5}} \right) = \left(\frac{2}{\sqrt{5}}, \frac{1}{\sqrt{5}} \right) $$

- To move 2 units along the line from A:

$$ \text{Scaled vector} = 2 \times \hat{u} = \left(\frac{4}{\sqrt{5}}, \frac{2}{\sqrt{5}} \right) $$

- Coordinates of the new point:

$$ (0 + \frac{4}{\sqrt{5}}, 3 + \frac{2}{\sqrt{5}}) $$

Numerically:

$$ \sqrt{5} \approx 2.236 $$

$$ \frac{4}{2.236} \approx 1.79 $$

$$ \frac{2}{2.236} \approx 0.894 $$

Final point:

$$ (0 + 1.79, 3 + 0.894) \approx (1.79, 3.89) $$

This point is approximately 2 units from A along the line.

Advanced Analytical Perspectives

Beyond basic calculations, several advanced analytical insights can be derived from the data:

Understanding the Line’s Behavior and Properties

- Line’s Slope: The slope of 1/2 indicates a gentle incline, meaning the line increases gradually as x increases.
- Y-intercept: The line crosses the y-axis at (0, 3), which is precisely point A.
- X-intercept: Set

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