

On A Coordinate Plane, Triangle A B C Has Points (negative 9, 3), (negative 9, 6), (0, 3) And Triangle

On A Coordinate Plane, Triangle A B C Has Points (negative 9, 3), (negative 9, 6), (0, 3) And Triangle – this specific configuration provides a fascinating example to explore the fundamentals of coordinate geometry, triangle properties, and how to analyze triangles plotted on the Cartesian plane. Understanding the positioning and measurements of these points allows students and enthusiasts of mathematics to deepen their comprehension of geometric principles, distance calculations, and the nature of triangles in coordinate systems. In this comprehensive guide, we will analyze the given points, determine the type of triangle formed, calculate side lengths, analyze angles, and discuss the properties and significance of such a geometric figure.

Understanding the Coordinates of Triangle ABC

Plotting the Points

The given points for Triangle ABC are:

- Point A: (-9, 3)
- Point B: (-9, 6)
- Point C: (0, 3)

Plotting these points on a coordinate plane allows us to visualize the triangle's shape and orientation.

Visual Representation

- Point A and B are vertically aligned since they share the same x-coordinate (-9).
- Point C is horizontally aligned with Point A, sharing the same y-coordinate (3).

This configuration suggests that the triangle has a vertical side between points A and B and a horizontal side between points A and C.

Coordinate Plane Overview

Understanding the coordinate plane is essential:

- The x-axis runs horizontally, with positive to the right and negative to the left.

- The y-axis runs vertically, with positive upward and negative downward.
- Each point is identified by its x (horizontal) and y (vertical) coordinates.

Calculating the Side Lengths of Triangle ABC

Using Distance Formula

To determine the length of each side of the triangle, we use the distance formula:

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

Applying this to each pair of points:

Side AB

- Coordinates: A (-9, 3), B (-9, 6)
- Calculation:

$$AB = \sqrt{(-9 - (-9))^2 + (6 - 3)^2} = \sqrt{0^2 + 3^2} = \sqrt{0 + 9} = 3$$

Side AC

- Coordinates: A (-9, 3), C (0, 3)
- Calculation:

$$AC = \sqrt{(0 - (-9))^2 + (3 - 3)^2} = \sqrt{9^2 + 0^2} = \sqrt{81 + 0} = 9$$

Side BC

- Coordinates: B (-9, 6), C (0, 3)
- Calculation:

$$BC = \sqrt{(0 - (-9))^2 + (3 - 6)^2} = \sqrt{9^2 + (-3)^2} = \sqrt{81 + 9} = \sqrt{90} \approx 9.49$$

Analyzing the Triangle: Types and Properties

Type of Triangle Based on Side Lengths

From the calculations:

- $AB \approx 3$ units
- $AC = 9$ units
- $BC \approx 9.49$ units

Since two sides (AC and BC) are approximately equal, and the third (AB) is shorter, Triangle ABC is an isosceles triangle.

Determining if the Triangle is Right-Angled

To check if the triangle has a right angle, we use the Pythagorean theorem:

- For sides of lengths a , b , and hypotenuse c :

$$a^2 + b^2 = c^2$$

Testing with the longest side, BC (~9.49):

$$AB^2 + AC^2 \approx 3^2 + 9^2 = 9 + 81 = 90$$

Compare with BC^2 :

$$(9.49)^2 \approx 90$$

Since $(AB^2 + AC^2 \approx BC^2)$, the triangle is right-angled with the right angle at point A.

Calculating Triangle Angles

Using the Law of Cosines

To find the angles, we apply the Law of Cosines:

$$a^2 = b^2 + c^2 - 2bc \cos(A)$$

$$\cos C = \frac{a^2 + b^2 - c^2}{2ab}$$

Where (a) , (b) , and (c) are the side lengths.

Angle at A

- Sides: AB (3), AC (9), BC (~9.49)

$$\cos A = \frac{AB^2 + AC^2 - BC^2}{2 \times AB \times AC}$$

$$\cos A = \frac{9 + 81 - 90}{2 \times 3 \times 9} = \frac{0}{54} = 0$$

$$A = \arccos(0) = 90^\circ$$

The calculation confirms the triangle has a right angle at A.

Angle at B

Similarly,

$$\cos B = \frac{AB^2 + BC^2 - AC^2}{2 \times AB \times BC}$$

$$\cos B = \frac{9 + 90 - 81}{2 \times 3 \times 9.49} \approx \frac{18}{56.94} \approx 0.316$$

$$B = \arccos(0.316) \approx 71.8^\circ$$

Angle at C

Since the angles must sum to 180° ,

$$C = 180^\circ - 90^\circ - 71.8^\circ \approx 18.2^\circ$$

Key Properties of Triangle ABC

- Type: Isosceles right triangle
- Right angle: At point A
- Side lengths:
- AB: 3 units

- AC: 9 units
- BC: approximately 9.49 units
- Angles:
- A: 90°
- B: approximately 71.8°
- C: approximately 18.2°

Practical Applications and Significance of Triangle ABC

Understanding Coordinate Geometry

Analyzing triangles like ABC helps students grasp concepts such as distance, slopes, and angles in coordinate geometry.

Real-World Applications

- Engineering: Design of structures and components.
- Navigation: Calculating shortest paths and angles.
- Computer Graphics: Rendering shapes based on coordinate points.
- Mathematics Education: Building foundational skills in geometry and trigonometry.

How to Use This Knowledge

- Plot points accurately on the coordinate plane.
- Calculate side lengths and angles to classify triangles.
- Use these principles to solve complex geometric problems.
- Apply the Pythagorean theorem and Law of Cosines for various triangle analyses.

Summary and Final Thoughts

Triangle ABC, defined by the points $(-9, 3)$, $(-9, 6)$, and $(0, 3)$, exemplifies a classic isosceles right triangle in the coordinate plane. Its unique properties—such as side lengths, angles, and shape—demonstrate fundamental concepts in coordinate geometry, including distance calculation, triangle classification, and angle measurement. Whether for academic purposes, practical applications, or enhancing spatial reasoning skills, analyzing such triangles is essential for mastering the fundamentals of geometry.

By understanding how to plot points, calculate distances, and analyze triangles, students and enthusiasts can develop a deeper appreciation for the elegance and utility of coordinate geometry in various fields. This exploration of Triangle ABC offers a comprehensive look at geometric principles, encouraging further study and application within the expansive world of mathematics.

Keywords for SEO Optimization:

- Triangle ABC coordinate plane
- Distance formula in geometry
- How to find side lengths in a triangle
- Isosceles right triangle
- Coordinate geometry tutorials
- Analyzing triangles on the Cartesian plane
- Calculating angles in coordinate triangles
- Practical applications of coordinate geometry

Frequently Asked Questions

What are the coordinates of the vertices of Triangle ABC?

The vertices are A(-9, 3), B(-9, 6), and C(0, 3).

How do you find the length of side AB in Triangle ABC?

Since A and B share the same x-coordinate, AB is a vertical segment. Length = $|6 - 3| = 3$ units.

What is the length of side AC in Triangle ABC?

Using the distance formula between points A(-9, 3) and C(0, 3): $|0 - (-9)| = 9$ units.

How do you determine if Triangle ABC is a right triangle?

Calculate the lengths of all sides and check if the Pythagorean theorem holds for any combination.

What is the area of Triangle ABC?

Using the base AC (length 9) and height (distance between B and line AC), the

area = $0.5 \times \text{base} \times \text{height} = 0.5 \times 9 \times 3 = 13.5$ square units.

What is the slope of the line segment BC?

Slope = $(6 - 3) / (-9 - 0) = 3 / -9 = -1/3$.

Is Triangle ABC a right triangle, and if so, which side is the hypotenuse?

Yes, it is a right triangle. The hypotenuse is side AC, which has length 9, and the right angle is at point B.

How do you find the perimeter of Triangle ABC?

Add the lengths of all sides: AB (3), AC (9), and BC (calculate using distance formula).

What are the coordinates of the centroid of Triangle ABC?

Centroid = $((-9 + -9 + 0)/3, (3 + 6 + 3)/3) = (-6, 4)$.

Additional Resources

On A Coordinate Plane, Triangle ABC Has Points $(-9, 3)$, $(-9, 6)$, $(0, 3)$

Understanding the properties and characteristics of triangles plotted on the coordinate plane is fundamental to grasping concepts in geometry and algebra. The specific triangle with vertices at $(-9, 3)$, $(-9, 6)$, and $(0, 3)$ offers a rich example to explore the principles of coordinate geometry, including calculating side lengths, slopes, area, and potential transformations. This detailed review will analyze the triangle's features, interpret its geometric significance, and discuss practical applications, making it a comprehensive guide for students, educators, and enthusiasts alike.

Overview of the Triangle's Coordinates

The triangle in question is defined by three points:

- Point A at $(-9, 3)$
- Point B at $(-9, 6)$
- Point C at $(0, 3)$

Plotting these points on the coordinate plane provides a visual foundation for further analysis.

Plotting the Points

- Point A (-9, 3): Located 9 units left of the origin along the x-axis and 3 units up along the y-axis.
- Point B (-9, 6): Shares the same x-coordinate as A but is 3 units higher on the y-axis.
- Point C (0, 3): Situated directly on the x-axis at the origin's horizontal level but 9 units to the right of Point A.

Plotting these points reveals that:

- A and B are vertically aligned, forming a vertical segment.
- A and C are horizontally aligned, forming a horizontal segment.

This setup indicates that the triangle has a right-angled structure, with one of its sides aligned along the axes.

Analyzing the Triangle's Properties

Understanding the properties of this triangle involves calculating side lengths, slopes, angles, and area. These calculations provide insight into its shape and size.

Calculating Side Lengths

Using the distance formula:

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

- Side AB: Vertical segment from (-9, 3) to (-9, 6):

$$d_{AB} = \sqrt{(-9 - (-9))^2 + (6 - 3)^2} = \sqrt{0^2 + 3^2} = 3$$

- Side AC: Horizontal segment from (-9, 3) to (0, 3):

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$$d_{AC} = \sqrt{(0 - (-9))^2 + (3 - 3)^2} = \sqrt{9^2 + 0^2} = 9$$

- Side BC: From (-9, 6) to (0, 3):

$$d_{BC} = \sqrt{(0 - (-9))^2 + (3 - 6)^2} = \sqrt{9^2 + (-3)^2} = \sqrt{81 + 9} = \sqrt{90} \approx 9.49$$

Summary of side lengths:

Side	Length	Notes
AB	3 units	Vertical side
AC	9 units	Horizontal side
BC	approximately 9.49 units	Diagonal side

This indicates that the triangle is scalene, with all sides of different lengths.

Calculating Slopes of Sides

Slopes help determine the orientation and angles:

- Slope of AB:

$$m_{AB} = \frac{6 - 3}{-9 - (-9)} = \frac{3}{0} \rightarrow \text{undefined}$$

Indicates a vertical line.

- Slope of AC:

$$m_{AC} = \frac{3 - 3}{0 - (-9)} = \frac{0}{9} = 0$$

Indicates a horizontal line.

- Slope of BC:

$$m_{BC} = \frac{3 - 6}{0 - (-9)} = \frac{-3}{9} = -\frac{1}{3}$$

This slope indicates a gentle downward incline from B to C.

Implications:

- The side AB is vertical.
- The side AC is horizontal.
- The side BC is sloped, forming a triangle with a right angle at A because AB and AC are perpendicular.

Geometric Features and Classification

Based on the calculated properties, the triangle exhibits specific features that classify its type.

Right Triangle Characteristics

Given that:

- AB is vertical.
- AC is horizontal.
- Their slopes are perpendicular (one is infinite, the other zero).

This confirms that triangle ABC is a right triangle with the right angle at point A.

Features of the Triangle

- Right Angle: At point A, where the vertical and horizontal sides meet.
- Legs: AB (3 units) and AC (9 units).
- Hypotenuse: BC (~9.49 units).

Advantages of Recognizing the Right Angle:

- Simplifies area calculation.
- Facilitates understanding of triangle properties and relationships.
- Provides opportunities for applying Pythagoras' theorem and trigonometry.

Calculating Area and Perimeter

The area and perimeter are crucial for understanding the size and boundary of the triangle.

Area Calculation

Since the triangle has a right angle at A, the area is straightforward:

$$\text{Area} = \frac{1}{2} \times \text{base} \times \text{height}$$

Using AB and AC as legs:

$$\text{Area} = \frac{1}{2} \times 3 \times 9 = 13.5$$

Result: The triangle's area is 13.5 square units.

Perimeter Calculation

Adding the lengths of all sides:

$$\text{Perimeter} = AB + AC + BC \approx 3 + 9 + 9.49 \approx 21.49$$

This perimeter indicates the total boundary length of the triangle.

Angles and Trigonometric Analysis

Understanding the angles in the triangle provides deeper insight.

Angles at the Vertices

- At Point A: Right angle (90°) by construction.
- At Point C: Using the slopes, the angle between AC and BC can be found with tangent:

$$\begin{aligned} \tan \theta &= \left| \frac{m_{AC} - m_{BC}}{1 + m_{AC} \times m_{BC}} \right| \\ &= \left| \frac{0 - (-\frac{1}{3})}{1 + 0 \times -\frac{1}{3}} \right| = \left| \frac{\frac{1}{3}}{1} \right| = \frac{1}{3} \end{aligned}$$

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\theta = \arctan \left( \frac{1}{3} \right) \approx 18.43^\circ
\]
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- At Point B: The remaining angle is:

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180^\circ - 90^\circ - 18.43^\circ \approx 71.57^\circ
\]
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Summary of angles:

Vertex	Approximate Angle
A	90°
C	18.43°
B	71.57°

This angular analysis confirms the triangle's acute and right-angled features.

Transformation and Practical Applications

Studying this triangle's placement and properties on the coordinate plane opens avenues for various geometric transformations and real-world applications.

Transformations

- Translation: Moving the triangle to a different position without changing its shape or size.
- Rotation: Rotating around a point (e.g., origin) to analyze orientation.
- Scaling: Increasing or decreasing size while maintaining proportions.

Applying these transformations helps in understanding symmetry, congruence, and similarity—core concepts in geometry.

Practical Applications

- Engineering and Architecture: Precise calculations of distances and angles for designing structures.
- Navigation and GIS: Using coordinate geometry for mapping and route planning.

- Computer Graphics: Rendering shapes and understanding coordinate transformations.

Pros and Cons of Analyzing this Triangle

Pros:

- Clear right-angled structure simplifies calculations.
- Coordinates provide exact numerical analysis.
- Demonstrates fundamental geometric principles like Pythagoras and trigonometry.
- Serves as an excellent example for teaching coordinate geometry concepts.

Cons:

- The specific coordinates may limit generalization without modifications.
- Slight complexity in calculating the hypotenuse and angles can be challenging for beginners.
- Assumes familiarity with distance and slope formulas.

Conclusion

The triangle with vertices at $(-9, 3)$, $(-9, 6)$, and $(0, 3)$ exemplifies a classic right triangle situated on the coordinate plane. Its properties—such as side lengths, angles, area, and perimeter—highlight core geometric principles and demonstrate the power of coordinate geometry.

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