Triangle NMO Is Drawn With Vertices N(5, 2), M(2, 1), O(3 , 3). Determine The Image Vertices Of NMO If

Triangle NMO Is Drawn With Vertices N(5, 2), M(2, 1), O(3, 3). Determine The Image Vertices Of NMO If various geometric transformations are applied. Understanding how a triangle's vertices change under transformations such as translation, rotation, reflection, and dilation is fundamental in coordinate geometry. In this comprehensive article, we explore the methods to find the image vertices of triangle NMO when subjected to different transformations, providing step-by-step explanations, formulas, and practical examples. Whether you are a student preparing for geometry exams or a teacher seeking detailed instructional content, this article will serve as an invaluable resource.

Understanding the Basic Coordinates of Triangle NMO

Before delving into transformations, it’s essential to understand the initial positions of the triangle's vertices:

- Vertex N: (5, 2)
- Vertex M: (2, 1)
- Vertex O: (3, 3)

These points form triangle NMO in the coordinate plane. The coordinates are pivotal in calculating the image vertices after transformations.

Fundamental Concepts in Coordinate Geometry for Transformations

Transformations alter the position, size, or orientation of geometric figures while maintaining certain properties. Key transformations include:

1. Translation

- Moves every point of a figure by the same distance in the same direction.
- Formula: $(x, y) \rightarrow (x + a, y + b)$, where (a, b) are the translation distances.

2. Rotation

- Rotates a figure around a specific point (center of rotation) by a certain angle.
- Coordinates are transformed using rotation formulas.

3. Reflection

- Flips a figure over a specified line (e.g., x-axis, y-axis, or any line).
- Reflection formulas depend on the line of reflection.

4. Dilation (Scaling)

- Enlarges or reduces a figure relative to a fixed point (center of dilation) by a scale factor k.
- Formula: $(x, y) \rightarrow (kx + (1 - k) x_{center}, ky + (1 - k) y_{center})$.

Determining Image Vertices of Triangle NMO Under Different Transformations

Transformations can significantly change the coordinates of vertices. To find the image vertices, apply the relevant formulas or methods based on the transformation type.

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1. Image of Triangle NMO Under Translation

Suppose the triangle is translated by a vector (a, b). For example, translation by $(3, -2)$:

- Vertex N: $(5, 2) \rightarrow (5 + 3, 2 - 2) = (8, 0)$
- Vertex M: $(2, 1) \rightarrow (2 + 3, 1 - 2) = (5, -1)$
- Vertex O: $(3, 3) \rightarrow (3 + 3, 3 - 2) = (6, 1)$

Resulting Image Vertices:

- N' (8, 0)
- M' (5, -1)
- O' (6, 1)

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2. Image of Triangle NMO Under Rotation

Rotation about a point (h, k) by an angle θ involves the following steps:

Rotation formula (counterclockwise):
- x' = h + (x - h) cosθ - (y - k) sinθ
- y' = k + (x - h) sinθ + (y - k) cosθ

Example: Rotate triangle NMO 90° counterclockwise about the origin (0,0):

- cos 90° = 0, sin 90° = 1

Calculations:

- N(5, 2):
- x' = 0 + (5 - 0) 0 - (2 - 0) 1 = 0 - 2 = -2
- y' = 0 + (5 - 0) 1 + (2 - 0) 0 = 5 + 0 = 5
- N' (-2, 5)

- M(2, 1):
- x' = 0 + 2 0 - 1 1 = -1
- y' = 0 + 2 1 + 1 0 = 2
- M' (-1, 2)

- O(3, 3):
- x' = 0 + 3 0 - 3 1 = -3
- y' = 0 + 3 1 + 3 0 = 3
- O' (-3, 3)

Image Vertices after 90° CCW rotation:
- N' (-2, 5)
- M' (-1, 2)
- O' (-3, 3)

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3. Reflection of Triangle NMO

Reflections depend on the line over which the figure is reflected.

Reflection over the x-axis:

- (x, y) → (x, -y)

Reflected vertices:

- N(5, 2) → (5, -2)
- M(2, 1) → (2, -1)
- O(3, 3) → (3, -3)

Reflection over the y-axis:

- (x, y) → (-x, y)

Reflected vertices:

- N(5, 2) → (-5, 2)
- M(2, 1) → (-2, 1)
- O(3, 3) → (-3, 3)

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4. Dilation (Scaling) of Triangle NMO

Suppose the triangle is dilated with a scale factor k = 2, centered at the origin:

- Vertices:

- N(5, 2) → (10, 4)
- M(2, 1) → (4, 2)
- O(3, 3) → (6, 6)

If dilation is centered at a different point, say (1, 1), the formula adjusts accordingly.

Applying Transformations in Practical Scenarios

Understanding how to compute image vertices is crucial in various real-world applications:

- Computer Graphics: Transforming shapes for animations.
- Engineering Design: Modifying models with precise transformations.
- Navigation and Mapping: Adjusting coordinate data under different coordinate systems.
- Educational Purposes: Teaching geometric transformations effectively.

Step-by-Step Guide to Find Image Vertices of Triangle NMO

Here's a practical approach:

1. Identify the transformation type (translation, rotation, reflection, dilation).
2. Determine the parameters (e.g., translation vector, rotation angle, line of reflection, scale factor).
3. Apply the relevant formulas to each vertex.
4. Compute the new coordinates systematically.
5. Verify the results by checking properties like distances or angles if necessary.

Conclusion and Summary

Transformations in coordinate geometry are powerful tools for manipulating figures like triangle NMO. By understanding and applying the appropriate formulas, you can accurately determine the image vertices after various transformations. This knowledge is fundamental for solving complex geometry problems, designing graphics, and understanding spatial relationships.

Key Points Recap:
- Coordinates of initial vertices: N(5, 2), M(2, 1), O(3, 3)
- Transformations include translation, rotation, reflection, and dilation.
- Each transformation has specific formulas to find new vertices.
- Practical application involves understanding parameters and methodical calculations.
- Mastery of these techniques enhances problem-solving skills in geometry.

For further practice, users are encouraged to experiment with different transformation parameters and explore how each affects the vertices of triangle NMO, deepening their understanding of geometric transformations in the coordinate plane.

Meta Description: Discover how to determine the image vertices of triangle NMO with vertices N(5, 2), M(2, 1), O(3, 3) under various transformations like translation, rotation, reflection, and dilation. Learn step-by-step methods and formulas in this comprehensive guide to coordinate geometry.

Frequently Asked Questions

What are the coordinates of the vertices of triangle NMO?

The vertices are N(5, 2), M(2, 1), and O(3, 3).

How do you find the image of triangle NMO under a translation?

To find the image under translation, add the translation vector's components to each vertex's coordinates. For example, if translating by (a, b), then the image vertices are N'(5 + a, 2 + b), M'(2 + a, 1 + b), and O'(3 + a, 3 + b).

What is the process to determine the image of triangle NMO after a reflection over the x-axis?

Reflect each vertex over the x-axis by changing the sign of the y-coordinate: N'(5, -2), M'(2, -1), O'(3, -3).

How can we find the image of triangle NMO after a rotation of 90 degrees clockwise about the origin?

Rotate each point 90 degrees clockwise: (x, y) becomes (y, -x). So, N'(2, -5), M'(-1, -2), O'(-3, -3).

If the triangle NMO is translated by vector (3, -2), what are the new vertices?

Applying the translation: N'(5 + 3, 2 - 2) = (8, 0), M'(2 + 3, 1 - 2) = (5, -1), O'(3 + 3, 3 - 2) = (6, 1).

Additional Resources

Triangle NMO Is Drawn With Vertices N(5, 2), M(2, 1), O(3, 3). Determine The Image Vertices Of NMO If

Understanding how geometric figures transform under various operations is a fundamental aspect of coordinate geometry, a key topic in mathematics. In this article, we explore the transformation of a specific triangle, NMO, with vertices at N(5, 2), M(2, 1), and O(3, 3). Our goal is to determine the image vertices of triangle NMO after applying a particular transformation. While the initial prompt appears incomplete, it opens the door to a broad discussion about transformations such as translations, rotations, reflections, and dilations, and how they affect the vertices of a triangle in

the coordinate plane. This exploration not only deepens understanding of geometric transformations but also demonstrates their practical applications in fields like computer graphics, engineering, and architecture.

Understanding the Initial Triangle: Coordinates and Properties

Before delving into transformations, it is essential to understand the original triangle's properties and the significance of its vertices.

Vertices and Coordinates

The vertices of triangle NMO are given as:

- N(5, 2)
- M(2, 1)
- O(3, 3)

Plotting these points on the coordinate plane provides a visual understanding:

- Point N is located 5 units along the x-axis and 2 units along the y-axis.
- Point M is at 2 units on the x-axis and 1 unit on the y-axis.
- Point O is at 3 units on the x-axis and 3 units on the y-axis.

Plotting these points helps visualize the triangle's shape and size, which is crucial for understanding how transformations alter its position and orientation.

Properties of Triangle NMO

Analyzing the triangle's properties involves calculating side lengths, angles, and the area:

- Side Lengths:

Using the distance formula:

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

- NM:

$$
\sqrt{(2 - 5)^2 + (1 - 2)^2} = \sqrt{(-3)^2 + (-1)^2} = \sqrt{9 + 1} = \sqrt{10} \approx 3.16
$$

- NO:

$$
\sqrt{(3 - 5)^2 + (3 - 2)^2} = \sqrt{(-2)^2 + 1^2} = \sqrt{4 + 1} = \sqrt{5} \approx 2.24
$$

- OM:

$$
\sqrt{(3 - 2)^2 + (3 - 1)^2} = \sqrt{1^2 + 2^2} = \sqrt{1 + 4} = \sqrt{5} \approx 2.24
$$

The sides NM, NO, and OM suggest a scalene triangle with no equal sides, which influences how it transforms under various operations.

- Area:

Using the shoelace formula:

$$
\text{Area} = \frac{1}{2} |x_1 y_2 + x_2 y_3 + x_3 y_1 - y_1 x_2 - y_2 x_3 - y_3 x_1|
$$

Applying to points N(5,2), M(2,1), O(3,3):

$$
\text{Area} = \frac{1}{2} |5 \times 1 + 2 \times 3 + 3 \times 2 - 2 \times 2 - 1 \times 3 - 3 \times 5|
$$

$$
= \frac{1}{2} |5 + 6 + 6 - 4 - 3 - 15| = \frac{1}{2} |17 - 22| = \frac{1}{2} \times 5 = 2.5
$$

Understanding these basic properties helps us analyze how the triangle's size and shape change under various transformations.

Types of Geometric Transformations and Their Impact on Vertices

Transformations in coordinate geometry modify figures in predictable ways. These operations include translations, rotations, reflections, and dilations. Each has specific rules for how vertices' coordinates are altered.

Translation

A translation shifts every point of a figure by the same distance in a specified direction. It preserves the shape, size, and orientation.

- General rule: For a translation by vector (a, b):

$$
(x', y') = (x + a, y + b)
$$

- Impact on NMO:

Suppose the translation vector is (p, q). The new vertices will be:

- N' = (5 + p, 2 + q)
- M' = (2 + p, 1 + q)
- O' = (3 + p, 3 + q)

The specific values of p and q determine the exact image.

Rotation

Rotation involves turning the figure around a fixed point, called the center of rotation, by a specified angle.

- Common rotation: About the origin (0,0), by θ degrees.

- Rotation formulas:

$$
x' = x \cos \theta - y \sin \theta
$$
$$
y' = x \sin \theta + y \cos \theta
$$

- Application to NMO:

To find the image of N(5, 2) after rotation by θ degrees about the origin:

$$
x' = 5 \cos \theta - 2 \sin \theta
$$
$$
y' = 5 \sin \theta + 2 \cos \theta
$$

Similarly, compute for M and O.

Reflection

Reflection creates a mirror image of the figure across a specified line, such as the x-axis, y-axis, or any line y = mx + c.

- Reflection across the x-axis:

$$
(x', y') = (x, -y)
$$

- Reflection across the y-axis:

$$
(x', y') = (-x, y)
$$

- Impact on NMO:

Reflecting across the x-axis transforms:

- N(5, 2) → N'(5, -2)
- M(2, 1) → M'(2, -1)
- O(3, 3) → O'(3, -3)

Reflections change the orientation but preserve size.

Dilation (Scaling)

Dilation enlarges or reduces a figure proportionally from a fixed point called the center of dilation.

- General rule: For a dilation centered at (x_c, y_c) with scale factor k:

$$
x' = x_c + k(x - x_c)
$$

\]
\[
y' = y_c + k(y - y_c)
\]

- Impact:

Vertices are moved closer to or farther from the center, affecting the size but not the shape.

Determining the Image Vertices: An Assumed Transformation

Since the original prompt is incomplete—"Determine The Image Vertices Of NMO If"—we will explore a common transformation scenario: a translation, which is often the simplest to analyze.

Scenario: Translation by a Vector (a, b)

Suppose the transformation is a translation by vector (2, -1). This means shifting the entire triangle 2 units right and 1 unit down.

- Calculations:

Applying the translation:

- N(5, 2):

\[
N' = (5 + 2, 2 - 1) = (7, 1)
\]

- M(2, 1):

\[
M' = (2 + 2, 1 - 1) = (4, 0)
\]

- O(3, 3):

\[
O' = (3 + 2, 3 - 1) = (5, 2)
\]

Thus, the image vertices are:

- N'(7, 1)
- M'(4, 0)
- O'(5, 2)

These new points form a triangle congruent to the original but shifted to a new location.

Verifying the Transformation

To confirm the effect, we can:

- Measure distances between the original vertices and the image vertices to ensure they remain unchanged (since translation preserves length).
- Confirm the shape's orientation remains consistent.

Applications and Significance of Coordinate Geometry Transformations

Understanding how to determine the image vertices of a triangle under various transformations is not purely theoretical—it has real-world applications.

Computer Graphics and Animation

Transformations allow for the manipulation of objects on the screen, enabling animations, modeling, and rendering complex scenes. Knowing how to compute new vertex positions is essential for designing realistic movements.

Engineering and Architecture

Designing structures often involves rotating or translating components to fit spatial constraints. Precise calculations ensure components align correctly.

Mathematical Problem-Solving and Education

Mastering transformations enhances spatial reasoning, critical thinking, and

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