Use The Rule (x,y) (3x,2y) To Find The Image For The Preimage Defined By The Given Points. PLEASE HELP!!!

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Introduction

Understanding transformations in coordinate geometry is fundamental for students and professionals alike who deal with geometric figures, graphs, and mappings. One common transformation involves applying a rule or function to a set of points (preimage) to obtain their images. This process is essential in various fields such as mathematics, engineering, computer graphics, and physics.

In this article, we will explore how to use the rule $(x,y) \rightarrow (3x, 2y)$ to find the image of given preimages, especially points in the coordinate plane. We will delve into the concept of transformations, how to apply the rule step-by-step, and provide illustrative examples to solidify your understanding. Whether you're a student preparing for exams or a professional working on geometric problems, this guide aims to clarify the process and make it accessible.

Understanding the Transformation Rule $(x,y) \rightarrow (3x, 2y)$

Before diving into examples, it's crucial to understand what the rule $(x,y) \rightarrow (3x, 2y)$ represents. This rule describes a specific type of transformation called a dilation combined with scaling along the axes.

- Preimage: The original set of points or shape before the transformation.
- Image: The resulting set of points after applying the transformation rule.

The rule $(x,y) \rightarrow (3x, 2y)$ indicates that each point in the preimage will be mapped to a new point whose x-coordinate is multiplied by 3 and y-coordinate by 2.

This transformation is a type of non-uniform scaling because it scales the x and y coordinates by different factors:

- Scaling factor for x-coordinate: 3
- Scaling factor for y-coordinate: 2

This transformation can be visualized as stretching the shape more along the x-axis than along the y-axis.

Why is This Important?

Understanding how to apply such rules is essential for:

- Graphing transformations: Visualizing how shapes change under different rules.
- Solving geometric problems: Finding the image of complex shapes.
- Coordinate geometry applications: Mapping points and figures in various fields.
- Computer graphics: Scaling images or objects along axes.

Now, let's explore how to perform this transformation step-by-step.

Step-by-Step Guide to Applying the Rule

Applying the rule $(x,y) \rightarrow (3x, 2y)$ to a point involves simple multiplication:

1. Identify the preimage points: These are given points in the coordinate plane.
2. Apply the transformation rule to each point:
- Multiply the x-coordinate by 3.
- Multiply the y-coordinate by 2.
3. Plot the new points: These points form the image of the original figure.

Let’s formalize this process:

Step 1: Write down the coordinates of the preimage point, say (x, y).

Step 2: Compute the new coordinates:

- $x' = 3 x$
- $y' = 2 y$

Step 3: The image point is (x', y').

Repeat these steps for each point in the preimage.

Example 1: Transform a Single Point

Suppose you are given a point P at (2, 3). Find its image P' under the rule $(x,y) \rightarrow (3x, 2y)$.

Solution:

- $x = 2$, $y = 3$
- $x' = 3 2 = 6$
- $y' = 2 3 = 6$

Result: P' is at (6, 6).

Example 2: Transform Multiple Points of a Shape

Consider a triangle with vertices at:

- A(1, 2)
- B(4, 3)
- C(2, 5)

Find the images of these points under the rule (x,y) → (3x, 2y).

Solution:

- For A(1, 2):
- x' = 3 1 = 3
- y' = 2 2 = 4
- A' = (3, 4)

- For B(4, 3):
- x' = 3 4 = 12
- y' = 2 3 = 6
- B' = (12, 6)

- For C(2, 5):
- x' = 3 2 = 6
- y' = 2 5 = 10
- C' = (6, 10)

The transformed triangle has vertices at (3, 4), (12, 6), and (6, 10).

Visualizing the Transformation

Visualizing the transformation can help understand its effect:

- The shape is stretched along the x-axis by a factor of 3.
- The shape is stretched along the y-axis by a factor of 2.
- The shape's proportions are altered, but the relative positions of points remain consistent in the transformed figure.

This visualization is especially useful in coordinate geometry and when graphing transformations manually or with software.

Applications of the Transformation (x,y) → (3x, 2y)

This type of transformation has several practical applications:

1. Graphic Design & Computer Graphics:

- Scaling images or objects along specific axes.
- Creating effects like stretching or compressing images.

2. Mathematics Education:

- Teaching students about transformations, dilations, and coordinate mapping.
- Visualizing how shapes change under different rules.

3. Engineering & Physics:

- Modeling physical phenomena where objects are scaled differently along axes.
- Simulating deformations or stretching in materials.

4. Mapping & Geospatial Analysis:

- Transforming coordinate data to fit different map projections.

5. Robotics & Animation:

- Calculating movements or deformations in simulated environments.

Common Mistakes and How to Avoid Them

While applying the transformation rule is straightforward, students often make some common errors:

- Multiplying both coordinates by the same factor: Remember, the rule specifies different factors for x and y.
- Confusing the order of operations: Always multiply the original coordinates by the factors before plotting the image points.
- Forgetting to transform all points: Ensure every point in the preimage is transformed, especially for polygons or complex shapes.
- Misreading the rule: Verify the transformation rule carefully before applying it.

To avoid these errors, double-check the transformation rule and practice with various points.

Practice Problems

1. Find the image of point D(0, 4) under the rule $(x,y) \to (3x, 2y)$.

2. Given a rectangle with vertices at (-1, -2), (3, -2), (3, 4), (-1, 4), find its image after applying the rule.

3. The preimage is a triangle with points at (2, -1), (5, 0), (3, 3). What are the image points?

4. A shape has a vertex at (−2, 3). Find its image after the transformation.

5. Plot the original shape with given points and their images after transformation to visualize the effect.

Answers:

1. D(0, 4) → (0, 8)
2. (-3, -4), (9, -4), (9, 8), (-3, 8)
3. (6, -2), (15, 0), (9, 6)

4. (−6, 6)
5. (Students should plot both original and transformed points to see the scaling effect.)

Conclusion

Applying the rule $(x,y) \rightarrow (3x, 2y)$ to find the image of points in the coordinate plane is a fundamental skill in coordinate geometry. It involves straightforward multiplication of each coordinate by its respective factor. This transformation results in a non-uniform scaling, stretching figures more along one axis than the other.

Mastering this process enhances your understanding of geometric transformations, helping you visualize complex shapes and solve related problems efficiently. Remember to carefully identify the preimage points, apply the rule systematically, and verify your results. With practice, applying such transformation rules will become second nature, empowering you to tackle more advanced topics in mathematics and related fields confidently.

Whether you're analyzing geometric figures, working on graphics, or exploring mathematical concepts, understanding how to use transformation rules like $(x,y) \rightarrow (3x, 2y)$ is an essential skill that broadens your mathematical toolkit. Keep practicing with different points and shapes to strengthen your understanding and visualization skills.

Frequently Asked Questions

What is the purpose of using the rule $(x,y) \rightarrow (3x, 2y)$ in coordinate transformations?

The rule $(x,y) \rightarrow (3x, 2y)$ is used to find the image of a point after a dilation or scale transformation, where the x-coordinate is multiplied by 3 and the y-coordinate by 2.

How do you apply the rule $(x,y) \rightarrow (3x, 2y)$ to a specific preimage point, say (4, 5)?

To find the image, multiply the x-coordinate by 3 and the y-coordinate by 2: $(4, 5) \rightarrow (3\times4, 2\times5) = (12, 10)$.

If the preimage point is (-2, 7), what is its image under the rule $(x,y) \rightarrow (3x, 2y)$?

Apply the rule: $(-2, 7) \rightarrow (3\times-2, 2\times7) = (-6, 14)$.

Can this rule be used to find images of points in all quadrants? Why or why not?

Yes, the rule applies to points in all quadrants because it uniformly scales the coordinates regardless of their sign, transforming preimages to their corresponding images.

What type of transformation does the rule (x,y) → (3x, 2y) represent?

It represents a dilation (scaling transformation) with a scale factor of 3 in the x-direction and 2 in the y-direction.

How would you find the image of a line segment with endpoints (1, 2) and (3, 4) using this rule?

Apply the rule to each endpoint: (1, 2) → (3×1, 2×2) = (3, 4) and (3, 4) → (3×3, 2×4) = (9, 8). The transformed line segment has endpoints (3, 4) and (9, 8).

What is the effect of the rule (x,y) → (3x, 2y) on the size and shape of geometric figures?

The rule enlarges figures by stretching them horizontally by a factor of 3 and vertically by a factor of 2, maintaining their shape but increasing their size.

If a point (x, y) is mapped to (3x, 2y), what is the inverse transformation?

The inverse transformation would be (X, Y) → (X/3, Y/2), reversing the scaling to find the original preimage point.

Why is it important to carefully follow the rule (x,y) → (3x, 2y) when finding images of multiple points?

Because each point is scaled individually according to the rule, careful application ensures accurate mapping of all points and correct transformation of the entire figure.

Additional Resources

Use The Rule (x,y) (3x,2y) To Find The Image For The Preimage Defined By The Given Points is a fundamental concept in coordinate geometry and transformations. This rule provides a systematic way to find the image of a set of points after a specific transformation is applied. Understanding how to utilize such rules is essential for students and professionals working in fields like mathematics, engineering, computer graphics, and physics. This article offers an in-depth exploration of the transformation rule, its application process, and practical examples to help clarify its use.

Understanding the Transformation Rule (x, y) → (3x, 2y)

What Is the Transformation Rule?

The rule (x, y) → (3x, 2y) describes a specific transformation applied to points in the coordinate plane. It takes each point with coordinates (x, y) and maps it to a new point with coordinates (3x, 2y).

- Scaling Transformation: This rule involves scaling the x-coordinate by a factor of 3 and the y-coordinate by a factor of 2.
- Transformation Type: It is a linear transformation that stretches or compresses the figure along the x- and y-axes.

Visualizing the Transformation

- If you imagine a point (x, y) on the plane, applying this rule moves the point to a new location.
- The scaling factors (3 for x, 2 for y) determine how much the figure enlarges or shrinks along each axis.
- The transformation is not uniform because the scale factors differ.

Applying the Rule to Find the Image of Given Points

Step-by-Step Process

Applying the rule involves a straightforward process:

1. Identify the preimage points: These are the original points given in the problem, typically represented as (x, y).

2. Apply the transformation rule to each point:
- Multiply the x-coordinate by 3.
- Multiply the y-coordinate by 2.

3. Plot or analyze the new points: The resulting points form the image of the original figure under the transformation.

Example:

Suppose you are given points A(1, 2) and B(4, 3). To find their images:

- For A(1, 2):
Image A' = (31, 22) = (3, 4)

- For B(4, 3):
Image B' = (34, 23) = (12, 6)

The transformed points are A'(3, 4) and B'(12, 6).

Features and Properties of the Transformation

Features

- Linear transformation: It scales points along axes, preserving lines and ratios.
- Non-uniform scaling: Different scale factors (3 and 2) result in stretching more along the x-axis.
- Coordinate-wise application: The transformation applies separately to x and y coordinates.

Properties

- Determinant of the transformation matrix:
The transformation can be represented as a matrix:

$$
\begin{bmatrix}
3 & 0 \\
0 & 2
\end{bmatrix}
$$

The determinant is $3 \times 2 = 6$, indicating the area scaling factor.

- Area change: The area of any shape is scaled by the determinant (6 times the original).

- Orientation: Since the scale factors are positive, the orientation of figures remains unchanged.

Advantages and Limitations of Using the Rule

Advantages

- Simplicity: Easy to apply to any set of points with basic multiplication.
- Predictability: Consistent scaling factors make it straightforward to determine the image.
- Versatility: Useful in various applications, including computer graphics, physics simulations, and geometric proofs.

Limitations

- Limited to linear transformations: Cannot handle rotations, translations, or non-linear transformations without modification.
- Assumes uniform application: Does not account for transformations that vary across the figure.
- Potential for misapplication: Mistakes in multiplication or application can lead to incorrect images.

Practical Examples and Exercises

Example 1: Find the Image of a Triangle

Given triangle with vertices P(1, 2), Q(3, 4), R(5, 6):

- P' = (31, 22) = (3, 4)
- Q' = (33, 24) = (9, 8)
- R' = (35, 26) = (15, 12)

The image triangle P'Q'R' is scaled accordingly.

Exercise: Find the image of points S(-2, 5) and T(0, 0)

- S' = (3 -2, 2 5) = (-6, 10)
- T' = (3 0, 2 0) = (0, 0)

Applications of the Transformation Rule

In Computer Graphics and Design

- Scaling objects uniformly or non-uniformly to create visual effects.
- Transforming coordinate models to fit different screen sizes or perspectives.

In Physics and Engineering

- Modeling physical systems where components stretch or compress differently.
- Transforming coordinate data in simulations.

In Mathematics and Geometry

- Understanding similarity, congruence, and proportionality.
- Analyzing how figures change under various transformations.

Conclusion and Final Tips

Using the rule (x, y) → (3x, 2y) to find the image of preimages is a fundamental skill in coordinate geometry. It exemplifies how simple algebraic operations can describe complex geometric transformations. To master this concept:

- Practice applying the rule to various points and figures.
- Understand the geometric implications of scaling factors.
- Recognize the properties preserved and altered under such transformations.

Remember that while applying the rule is straightforward, careful attention to detail is essential to avoid errors. With consistent practice, this transformation process becomes an intuitive and powerful tool for analyzing and manipulating geometric figures.

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Final Note: Always verify your results by plotting points or considering the
effect of scaling on figures to develop a deeper understanding of the
transformation's impact on geometry.
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