

Transformation That Result In A Change In The Size Of A Figure Are Called ____.

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In the realm of geometry and mathematics, understanding how figures can change and transform is fundamental. Transformations are operations that alter the position, size, or shape of a geometric figure. Among these, some transformations specifically lead to a change in the size of the figure, which is a crucial concept in both pure and applied mathematics. These particular types of transformations are known as dilations or scaling transformations. Recognizing and understanding these transformations is essential for students, educators, architects, engineers, and anyone involved in design or spatial reasoning.

In this comprehensive article, we will explore the nature of transformations that result in a change in the size of a figure, their properties, types, and applications. Whether you are a student preparing for exams, a teacher designing lessons, or a professional working with geometric models, understanding these transformations will deepen your grasp of geometric concepts and their practical applications.

Understanding Geometric Transformations

Before delving into transformations that change the size of a figure, it is vital to have a clear understanding of what geometric transformations are.

What Are Geometric Transformations?

Geometric transformations are operations that move or change figures in a coordinate plane or space. These transformations can:

- Preserve the size and shape of the figure (congruence transformations)
- Alter the size and shape of the figure (similarity transformations)
- Change the figure's position without affecting its size or shape (translations)
- Rotate the figure around a point (rotations)
- Flip the figure over a line (reflections)
- Resize the figure proportionally (scaling or dilation)

The main goal of studying transformations is to understand how figures can be manipulated while maintaining certain properties.

Types of Geometric Transformations

The primary types of transformations include:

- Translation: Moving a figure from one location to another without rotating or resizing.
- Rotation: Turning a figure about a fixed point through a specified angle.
- Reflection: Flipping a figure over a line to produce a mirror image.
- Scaling (Dilation): Resizing a figure proportionally, which can either enlarge or reduce the figure.
- Shear: Slanting the shape of a figure along a certain axis.

Among these, scaling or dilation is the transformation that specifically results in a change in the size of the figure.

Transformations That Change the Size of a Figure

Definition of Dilation or Scaling

Dilation (also called scaling) is a transformation that enlarges or reduces a figure by a scale factor relative to a fixed point called the center of dilation.

Key Characteristics of Dilation:

- It produces a similar figure to the original, meaning the shape remains unchanged.
- The size of the figure is changed proportionally.
- The transformation is determined by the scale factor and the center of dilation.

Center of Dilation: The fixed point about which the figure is expanded or contracted.

Scale Factor: A number that determines how much the figure is enlarged or reduced.

- If the scale factor > 1 , the figure enlarges.
- If the scale factor between 0 and 1, the figure reduces.
- If the scale factor $= 1$, the figure remains unchanged.

Why Are These Transformations Important?

Understanding dilation is fundamental in various fields such as:

- Architecture: Designing structures at different scales.
- Engineering: Creating models and prototypes.
- Art: Scaling drawings and sculptures.
- Mathematics: Establishing similarity and proportionality.

They also serve as the foundation for more complex transformations and concepts like similarity and fractals.

Properties of Dilation (Scaling) Transformations

Understanding the properties of dilations helps in recognizing their effects and applications.

Similar Figures

- After dilation, the original figure and the image are similar.
- Corresponding angles are equal.
- Corresponding sides are proportional.

Proportionality of Sides

- If a figure is scaled by a factor k , then every length in the image is k times the original length.

Center and Scale Factor

- The size change depends on the center of dilation and scale factor.
- The position of the figure relative to the center influences the size and position of the dilated figure.

Coordinate Rules for Dilation

In the coordinate plane, if a point (x, y) is dilated with respect to a center (h, k) and scale factor s , the image (x', y') is calculated as:

$$\begin{aligned} x' &= h + s(x - h) \\ y' &= k + s(y - k) \end{aligned}$$

This formula helps in performing dilation transformations directly on coordinate points.

Types of Dilation or Scaling Transformations

Dilation transformations are categorized based on the scale factor and the center of dilation.

1. Uniform Dilation

- The figure is scaled uniformly in all directions.
- The scale factor is the same in every direction.
- Example: Enlarging a square by a scale factor of 2.

2. Non-Uniform Dilation

- The figure is scaled differently along different axes.
- Often involves stretching or compressing along specific directions.
- Used in more complex geometric transformations and modeling.

3. Dilation About the Origin

- The center of dilation is at the origin (0,0).
- The transformation simplifies to multiplying the coordinates by the scale factor:

$$\begin{aligned} & \backslash [\\ (x, y) & \rightarrow (s \times x, s \times y) \\ & \backslash] \end{aligned}$$

- Common in coordinate geometry problems.

4. Dilation About an Arbitrary Point

- The center of dilation is any point (h, k).
- Coordinates are adjusted relative to this point using the formulas mentioned earlier.

Applications of Transformations That Change Size

Understanding and applying dilation transformations have numerous practical uses across various domains.

Architectural Design

- Creating scaled models of buildings.
- Visualizing structures at different sizes before construction.

Engineering and Manufacturing

- Producing prototypes.
- Scaling designs for different product sizes.

Art and Graphics

- Creating proportionally scaled artwork.
- Resizing images and illustrations without distortion.

Mathematics and Education

- Teaching concepts of similarity and proportionality.
- Solving problems related to scale drawings and models.

Computer Graphics and Animation

- Scaling objects in digital environments.
- Implementing zoom functions and perspective adjustments.

Summary and Key Takeaways

- Transformations that result in a change in the size of a figure are called dilations or scaling transformations.
- They are characterized by a center of dilation and a scale factor.
- The primary property of dilation is that it produces similar figures, with side lengths scaled proportionally.
- These transformations are essential in practical applications like architecture, engineering, art, and computer graphics.
- Coordinate geometry formulas facilitate performing dilations in the coordinate plane.

Conclusion

Transformations that change the size of a figure, specifically dilations, play a vital role in understanding geometric relationships and real-world applications. Recognizing the properties, types, and methods to perform these transformations allows for better visualization, design, and analysis of

shapes and structures. Whether enlarging a blueprint, resizing a digital image, or creating scaled models, the concept of dilation remains central to the study of geometry and its practical implementations.

By mastering these transformations, students and professionals alike can develop a deeper appreciation of the proportional relationships that govern the physical and digital worlds.

Frequently Asked Questions

What are transformations that cause a change in the size of a figure called?

They are called dilations or scaling transformations.

In geometry, what term describes transformations that alter the size but not the shape of a figure?

The term is dilation or scaling.

Which type of transformation changes the size of a figure while maintaining its shape?

A dilation or a similar scaling transformation.

What is the name of the transformation that results in a figure becoming larger or smaller?

It is called dilation or scaling.

Are transformations that change a figure's size called similar transformations?

They are related to similar transformations, specifically dilations, which change size but preserve shape.

What is the mathematical term for enlarging or reducing a figure proportionally?

The term is dilation.

Do transformations that change size but not shape include reflections and rotations?

No, reflections and rotations preserve size; transformations that change size are dilations or scalings.

In coordinate geometry, what transformation results in a similar figure with different size?

A dilation or scaling transformation.

What term describes a transformation that results in a change in the size of a geometric figure?

The transformation is called a dilation or scaling transformation.

Additional Resources

Transformation That Result In A Change In The Size Of A Figure Are Called dilations, a fundamental concept in geometry that plays a crucial role in understanding how figures behave under various transformations. These transformations are part of the broader family of geometric transformations that also include translations, rotations, and reflections. However, dilation is unique because it specifically involves resizing a figure either larger or smaller, while maintaining its shape and proportionality. This article aims to explore dilations comprehensively, discussing their properties, types, applications, and significance in both mathematical theory and real-world contexts.

Understanding Dilation: The Basics

Dilation, sometimes referred to as "resizing" or "enlargement/reduction," is a transformation that produces an image similar to the original figure but with a different size. Unlike transformations such as translation or rotation, which preserve size and shape, dilation changes the size while maintaining the original shape's proportions. This characteristic makes dilations particularly useful in similar figures and scale modeling.

Definition of Dilation

A dilation is a transformation that produces an image that is similar to the original figure, with the size scaled by a specific factor called the scale factor. The process involves a fixed point called the center of dilation—the point about which the figure is enlarged or reduced.

Key Components of Dilation

- Center of Dilation: The fixed point in the plane about which the figure is enlarged or reduced.
- Scale Factor (k): A number that indicates how much the figure is enlarged or reduced.
- If $|k| > 1$, the figure is enlarged.
- If $|k| < 1$, the figure is reduced.
- If $|k| = 1$, the figure remains unchanged.
- Original Figure: The pre-image before transformation.
- Image: The resulting figure after dilation.

Types of Dilation

Dilations are classified primarily based on the scale factor and the position of the figure relative to the center of dilation.

1. Enlargement (Scaling Up)

When the scale factor $|k| > 1$, the figure becomes larger. The image is similar to the original but with increased size.

2. Reduction (Scaling Down)

When $0 < |k| < 1$, the figure becomes smaller, maintaining the shape but decreasing in size.

3. Reflection through the Center

If the scale factor is negative, the image is reflected across the center of dilation, effectively flipping the figure over.

4. Similarity and Dilation

All dilations produce similar figures, meaning their corresponding angles are equal, and their sides are in proportional lengths.

Mathematical Representation of Dilation

The algebraic expression for a dilation with center at the origin $(0,0)$ and scale factor k is straightforward:

- For a point (x, y) , the image (x', y') is:

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

When the center of dilation is not at the origin, the process involves translating the figure so that the center is at the origin, performing the dilation, then translating back.

Example:

Suppose a point $A(2, 3)$ undergoes a dilation centered at $C(0, 0)$ with scale factor 3:

- Image $A' = (3 \cdot 2, 3 \cdot 3) = (6, 9)$

If the dilation is centered at $C(1, 1)$, the process involves more steps:

- Translate A and C so that C maps to the origin:

- A translated: $(2 - 1, 3 - 1) = (1, 2)$

- Perform dilation:

- $(1 \cdot k, 2 \cdot k)$ (with k depending on the scale factor)

- Translate back to original position.

Properties of Dilation

Understanding the properties of dilation helps in recognizing its effects and applications:

- Similarity: The original and the dilated figure are similar; corresponding angles are equal.
- Proportional Sides: Corresponding sides are in proportion, scaled by the scale factor.
- Preservation of Shape: Dilation does not alter the shape, only the size.
- Center-dependent: The position of the center of dilation influences the location of the image.
- Orientation: If the scale factor is positive, the figure maintains its orientation; if negative, it is reflected.

Applications of Dilation

Dilations are not just theoretical constructs but have numerous practical applications across different fields.

1. Scale Models and Maps

Architects and engineers use dilations to create scale models of buildings and maps, allowing for manageable representations of large structures or terrains.

2. Art and Design

Artists utilize dilation principles when creating proportional enlargements or reductions in artworks and graphic designs.

3. Computer Graphics and Animation

Transformations involving dilation are fundamental in scaling images, objects, and characters to different sizes without distortion.

4. Geometry and Mathematics Education

Teaching concepts of similarity, proportionality, and transformations often involve dilations to illustrate core principles visually.

5. Science and Engineering

In physics and engineering, dilations help in modeling phenomena where size or scale changes are relevant, such as optics or material science.

Pros and Cons of Dilation

Understanding the benefits and limitations of dilation can help in applying this transformation effectively.

Pros:

- Preserves shape and angles, making figures similar.
- Useful for creating scaled representations.
- Simplifies complex problems involving proportionality.
- Fundamental in understanding similarity and congruence.

Cons:

- Only applicable to figures that can be scaled proportionally.
- Requires precise knowledge of the center of dilation and scale factor.
- Negative scale factors introduce reflection, which may complicate interpretation.
- Not suitable for transformations that require preservation of size.

Conclusion

Transformation That Result In A Change In The Size Of A Figure Are Called dilations, and they are integral to the study of geometry due to their ability to produce similar figures with different sizes. By understanding the properties, types, and applications of dilation, students and professionals can better analyze geometric figures and solve real-world problems involving scaling. Whether in creating models, designing graphics, or exploring mathematical concepts, dilations provide a powerful tool for understanding how figures change in size while maintaining their shape and proportions. Recognizing the significance of the scale factor, the role of the center of dilation, and the principles of similarity enhances both theoretical understanding and practical application of this fundamental transformation.

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