

The Shape Below Is Enlarged Using A Scale Factor Of 3 And Centre (3,7) To Give The Dashed Shape.What

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Understanding geometric transformations is fundamental in the study of mathematics, especially in coordinate geometry. One of the most common transformations is dilation or enlargement, which involves resizing a shape relative to a fixed point known as the center of enlargement. In this article, we explore what happens when a shape is enlarged using a scale factor of 3 with the specific center at (3,7), and how this process results in a larger, dashed version of the original shape. We will delve into the concepts of scale factors, centers of enlargement, the steps to perform such transformations, and their applications in real-world contexts.

What Is Enlargement in Geometry?

Enlargement, also referred to as dilation, is a transformation that changes the size of a geometric figure while preserving its shape and the proportions of its sides. The key features of enlargement include:

- Scale Factor: A number that determines how much the figure is enlarged or reduced.
- Center of Enlargement: A fixed point about which all points of the shape are moved during the transformation.
- Resulting Shape: Similar to the original, but scaled in size according to the scale factor.

In the context of the given problem, the original shape is scaled by a factor of 3, meaning the figure is tripled in size, with the center at (3,7).

Understanding the Components of the Transformation

Centre of Enlargement (3,7)

The point (3,7) acts as the pivotal point around which the shape is enlarged. Every point on the original shape moves along a straight line passing through this center. The distance from each point to the center is multiplied by the

scale factor, resulting in the larger, dashed shape.

Scale Factor of 3

A scale factor of 3 indicates that each point of the original shape is moved three times farther from the center of enlargement. For example:

- If a point is 2 units from the center, it will move to a position 6 units away.
- If a point is 5 units away, it will now be 15 units away.

This uniform scaling maintains the shape's proportions, making the enlarged figure similar to the original but larger.

How to Perform the Enlargement Step-by-Step

Performing the enlargement involves manipulating each vertex of the original shape. Here's a systematic approach:

Step 1: Identify All Vertices

Write down the coordinates of all vertices of the original shape.

Step 2: Calculate the Distance and Direction from the Center

For each vertex (x, y) :

- Find the difference in x-coordinates: $\Delta x = x - 3$
- Find the difference in y-coordinates: $\Delta y = y - 7$

Step 3: Multiply the Differences by the Scale Factor

- New $\Delta x' = 3 \times \Delta x$
- New $\Delta y' = 3 \times \Delta y$

Step 4: Find the Coordinates of the Enlarged Vertex

- New x-coordinate: $x' = 3 + \Delta x'$

- New y-coordinate: $y' = 7 + \Delta y'$

Repeat this process for each vertex to obtain the vertices of the dashed, enlarged shape.

Visualizing the Transformation

Visual aids greatly enhance understanding. When the original shape is scaled by a factor of 3, each point moves along a straight line passing through (3,7). The original vertices are closer to the center, and their images are farther away, creating a larger similar shape.

In a typical diagram:

- The original shape is drawn with solid lines.
- The enlarged shape, scaled by factor 3, is shown with dashed lines.
- All vertices of the dashed shape are positioned according to the calculations above.

This visual distinction helps in understanding the nature of the transformation clearly.

Applications of Scale Transformations in Real Life

Understanding how to perform and interpret enlargements has numerous practical applications:

- **Engineering and Design:** Creating scaled models of structures or machinery.
- **Cartography:** Enlarging or reducing map sections while maintaining proportions.
- **Art and Architecture:** Scaling drawings and plans accurately.
- **Computer Graphics:** Transforming images and objects within a digital space.

In all these applications, maintaining the shape's proportions and understanding the role of the center of enlargement are crucial.

Common Challenges and Tips

Transformations involving scale factors and centers can sometimes be confusing. Here are some tips:

- Always identify the center of enlargement first.
- Use a systematic approach to find new coordinates.
- Keep track of the scale factor's effect on distances.
- Practice with various shapes to build confidence.

Additionally, when drawing the enlarged shape, ensure the lines are accurately scaled and the vertices are correctly positioned.

Conclusion

Enlarging a shape using a scale factor of 3 about the center (3,7) results in a similar, larger figure, often depicted with dashed lines to distinguish it from the original. This process involves understanding the concepts of scale factors and centers of enlargement, applying coordinate geometry formulas, and visualizing the transformation. Mastering this technique is essential for various fields, including engineering, art, and computer graphics, where precise scaling and transformations are vital. By carefully performing each step and practicing with different figures, learners can develop a strong grasp of geometric transformations and their applications.

Understanding these principles not only enhances mathematical skills but also provides valuable tools for real-world problem-solving and design tasks.

Frequently Asked Questions

What is the scale factor used to enlarge the shape below?

The scale factor used is 3.

What is the center of enlargement for the shape?

The center of enlargement is at the point (3, 7).

How does the scale factor of 3 affect the size of the shape?

It enlarges the shape to three times its original size from the center point.

What is the purpose of the dashed shape in the diagram?

The dashed shape represents the enlarged image of the original shape after applying the scale factor.

How do you find the coordinates of a point after enlargement?

Multiply the vector from the center of enlargement to the point by the scale factor, then add back the center coordinates.

If a point of the original shape is at (x, y) , what are its coordinates after enlargement?

The new coordinates are given by: $(3 + 3(x - 3), 7 + 3(y - 7))$.

Why is the point $(3, 7)$ unchanged after enlargement?

Because the point $(3, 7)$ is the center of enlargement, so it remains fixed during the transformation.

How can you verify that the dashed shape is the correct enlargement?

Check that all points of the dashed shape are scaled appropriately from the center $(3, 7)$ by the scale factor of 3, maintaining proportional distances.

Additional Resources

The Shape Below Is Enlarged Using A Scale Factor Of 3 And Centre $(3,7)$ To Give The Dashed Shape. What?

Understanding geometric transformations is fundamental in both pure mathematics and practical applications such as engineering, computer graphics, and design. Among these transformations, scaling plays a pivotal role in resizing figures while maintaining their shape and proportions. When a figure is enlarged or reduced relative to a fixed point called the centre of dilation, the process is termed as a scale transformation. This article explores the intricacies of such a transformation, specifically focusing on how a shape is enlarged using a scale factor of 3 with the centre at $(3,7)$, resulting in a new, dashed shape. We will analyze the principles, mathematical procedures, and implications of this transformation in a detailed and comprehensive manner.

Understanding Geometric Scaling: The Basics

What Is Scaling in Geometry?

Scaling is a transformation that enlarges or reduces a figure proportionally relative to a fixed point known as the centre of dilation. When a figure is scaled:

- All points of the figure are moved along straight lines passing through the centre.
- The distances from the centre to each point are multiplied by a scale factor.
- The shape remains similar; only the size changes.

A scale factor greater than 1 results in an enlargement, while a scale factor less than 1 (but greater than 0) results in a reduction.

Centre of Dilation

The centre of dilation is a specific point about which the figure is enlarged or reduced. Its position heavily influences the final shape's placement. In our case, this centre is at (3,7), a coordinate on the Cartesian plane.

Scale Factor

The scale factor indicates how much the figure is enlarged or reduced:

- Scale factor of 3: The figure's size triples.
- The scale factor directly affects the distances from the centre to each point.

Mathematical Framework of the Transformation

Coordinate Transformation Formula

Given a point $P(x, y)$, the corresponding point $P'(x', y')$ after dilation with centre $C(a, b)$ and scale factor k is given by:

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

$$y' = b + k(y - b)$$

This formula ensures that:

- When $(k > 1)$, points move away from the centre, enlarging the figure.
- When $(0 < k < 1)$, points move closer to the centre, reducing the figure.

In our context:

- $(a = 3)$, $(b = 7)$
- $(k = 3)$

Applying the Formula: Step-by-Step

To find the position of each point of the original shape after transformation:

1. Subtract the centre coordinates from the point's coordinates.
2. Multiply the difference by the scale factor.
3. Add back the centre coordinates to find the new point.

Practical Application: Enlarging the Shape

Initial Shape Specification

While the original shape's specific points are not provided explicitly, typical problems involve polygons such as triangles, rectangles, or more complex polygons. The process remains consistent:

- List all vertices of the original shape.
- Apply the coordinate transformation to each vertex.
- Connect the transformed points to form the enlarged shape.

Example: Hypothetical Coordinates

Suppose the original shape has vertices:

- $(P_1(1, 2))$
- $(P_2(4, 5))$
- $(P_3(2, 6))$

Applying the transformation:

For $(P_1(1, 2))$:

$$\begin{aligned}x'_1 &= 3 + 3(1 - 3) = 3 + 3(-2) = 3 - 6 = -3 \\y'_1 &= 7 + 3(2 - 7) = 7 + 3(-5) = 7 - 15 = -8\end{aligned}$$

For $(P_2(4, 5))$:

$$\begin{aligned}x'_2 &= 3 + 3(4 - 3) = 3 + 3(1) = 3 + 3 = 6 \\y'_2 &= 7 + 3(5 - 7) = 7 + 3(-2) = 7 - 6 = 1\end{aligned}$$

For $(P_3(2, 6))$:

$$\begin{aligned}x'_3 &= 3 + 3(2 - 3) = 3 + 3(-1) = 3 - 3 = 0 \\y'_3 &= 7 + 3(6 - 7) = 7 + 3(-1) = 7 - 3 = 4\end{aligned}$$

The transformed vertices form the enlarged shape with coordinates:

- $(P'_1(-3, -8))$
- $(P'_2(6, 1))$
- $(P'_3(0, 4))$

Plotting these points and connecting them yields the dashed, enlarged shape.

Visual and Geometric Implications

Shape Similarity and Proportionality

The enlarged shape remains similar to the original, meaning:

- Corresponding angles are equal.
- Corresponding sides are proportional, with a ratio equal to the scale factor (3 in this case).

This similarity is crucial in fields like architecture and design, where

maintaining proportions is essential when resizing.

Position and Orientation

The shape's position shifts depending on the location of the original shape relative to the centre. Since the centre is at (3,7), points located closer or farther from this point are affected differently:

- Points farther from the centre move more significantly.
- The shape enlarges uniformly, preserving its overall structure.

Orientation remains unchanged since dilation is a uniform transformation.

Impact of the Centre of Dilation

Choosing (3,7) as the centre influences the final position:

- Shapes closer to (3,7) undergo smaller positional shifts.
- Shapes farther away move more dramatically.

This concept is vital when designing scaled models or diagrams, as the placement relative to the centre affects the final layout.

Real-World Applications and Significance

Engineering and Manufacturing

In engineering, scaling transformations ensure that prototypes or models are accurately enlarged or reduced, maintaining proportionality and structural integrity. For example, scaling a blueprint involves similar principles, with the centre often chosen for convenience or technical reasons.

Computer Graphics and Animation

Digital modeling relies heavily on scaling transformations. When enlarging objects, the center point determines how the object expands—whether from a specific anchor point or the object's centroid.

Architectural Design

Architects often create scaled drawings of structures. Understanding how to perform precise dilations around a chosen point helps in creating accurate

representations and modifications.

Educational Contexts and Mathematical Visualization

Teaching concepts of similarity, scaling, and transformations enhances spatial reasoning and comprehension of geometric principles. Visualizing how a shape enlarges around a specific point deepens understanding of coordinate geometry.

Potential Challenges and Considerations

Accuracy in Calculation

Applying the coordinate transformation formula requires precision. Small errors can lead to incorrect final shapes, which emphasizes the importance of meticulous computation, especially when dealing with complex polygons.

Choosing the Centre of Dilation

The centre's position influences the final shape's location. An inappropriate choice may result in undesired shifts or overlaps, especially in composite designs.

Graphical Representation

Plotting the original and transformed shapes accurately on graph paper or digital software ensures visual confirmation of the transformation's correctness.

Limitations of Scaling

While dilation preserves shape similarity, it does not account for other transformations like rotation or reflection. Combining these transformations requires careful analysis.

Conclusion: The Significance of Understanding

Dilation

The transformation of a shape through enlargement with a specific scale factor and centre is a fundamental concept in geometry, with broad applications across various fields. Using the given parameters—scale factor of 3 and centre at (3,7)—demonstrates the principles of similarity, proportionality, and spatial reasoning. By understanding the mathematical foundation, practical procedures, and implications, learners and professionals can accurately manipulate shapes, create scaled models, and interpret geometric transformations in real-world contexts.

This detailed exploration underscores not only the mechanics behind dilation but also its significance in design, engineering, education, and beyond. Recognizing how a shape is transformed helps in designing precise models, understanding proportional relationships, and fostering a deeper appreciation of the elegance inherent in geometric transformations.

In essence, the original shape, when enlarged by a scale factor of 3 about the centre (3,7), produces the dashed shape through a systematic process of coordinate transformation. This process exemplifies the power and utility of geometric principles in both theoretical and applied disciplines, bridging abstract mathematics with tangible real-world applications.

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