NEED HELP 50 POINTS!!! Which Graph Shows The Result Of Dilating This Figure By A Factor Of One-third

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Understanding Geometric Dilation: An Essential Concept in Geometry

What Is Geometric Dilation?

Geometric dilation, also known as scaling, is a transformation that enlarges or reduces a figure by a specific factor relative to a fixed point, called the center of dilation. Unlike translation or rotation, dilation changes the size of the figure but preserves the shape and the proportional relationships between the parts of the figure.

The key aspect of dilation is the scale factor, which determines how much the figure is enlarged or reduced:

- A scale factor greater than 1 results in an enlarged figure.
- A scale factor less than 1 (but greater than 0) results in a reduced figure.
- A scale factor of exactly 1 leaves the figure unchanged.

In this context, the scale factor of one-third (1/3) indicates that the figure is reduced to a third of its original size.

Center of Dilation

The transformation depends on a fixed point called the center of dilation. The figure is scaled relative to this point, meaning:

- All points on the figure move along lines radiating from the center.
- The distance from the center to each point on the figure is scaled by the factor.

Choosing the correct center of dilation is crucial for understanding how the figure changes and for accurately identifying the resulting graph.

How Dilation Affects a Geometric Figure

Effects on Size and Shape

When a figure undergoes dilation by a factor of one-third:

- The figure’s size shrinks to 33.33% of its original size.
- The shape of the figure remains unchanged (similar figures).
- All linear measurements (lengths, widths, heights) are scaled down proportionally.

Effects on Coordinates and Graphs

If the figure is represented on a coordinate plane, the coordinates of each point are scaled relative to the center of dilation:

- For a center at the origin (0,0), each coordinate (x, y) becomes (x/3, y/3).
- If the center is elsewhere, the transformation involves more steps:
1. Subtract the center coordinates from each point.
2. Multiply the resulting differences by 1/3.
3. Add back the center coordinates to obtain the new position.

This process produces a smaller, similar figure that maintains the same shape as the original.

Identifying the Correct Graph After Dilation

Key Features to Look For

When choosing the graph that shows the dilated figure, consider these points:

- Size Reduction: The figure should be smaller but similar in shape.
- Proportionality: The ratios of corresponding sides should be approximately one-third of the original.
- Position Relative to the Center: The figure should be scaled about the same center point; if the center is at a specific coordinate, the dilated figure should be proportionally closer to that point.
- Orientation: The shape's orientation remains unchanged unless the dilation involves reflection or rotation, which is not indicated here.

Common Mistakes to Avoid

- Selecting a graph where the figure appears larger instead of smaller.
- Choosing a graph where the figure is shifted in position without proper scaling.
- Confusing dilation with other transformations such as translation, rotation, or reflection.

Step-by-Step Approach to Solve the Problem

1. Understand the Original Figure

- Identify the original figure’s size, shape, and position.
- Note the coordinates of key points, if available.

2. Determine the Center of Dilation

- Check if the problem specifies the center or if it is at a standard point like the origin.
- If unspecified, assume the origin for simplicity unless context suggests otherwise.

3. Calculate the Expected Coordinates of the Dilated Figure

- For each key point (x, y), compute the new position as:

$$
(x', y') = \left(\text{center}_x + \frac{(x - \text{center}_x)}{3}, \quad \text{center}_y + \frac{(y - \text{center}_y)}{3} \right)
$$

- This formula ensures the figure is scaled down by a factor of 1/3 with respect to the center.

4. Analyze the Graphs Provided

- Look for figures that match the calculated scaled coordinates.
- Ensure the figure maintains the same shape and is proportionally smaller.
- Confirm the position relative to the center.

5. Select the Correct Graph

- Choose the graph where the figure appears proportionally reduced and correctly positioned.

Visualizing the Dilation Process

Example: Dilation About the Origin

Suppose the original figure has points at (6, 9), (3, 6), and (6, 3). Dilation by a factor of 1/3 about the origin results in:

- (6, 9) → (6/3, 9/3) = (2, 3)
- (3, 6) → (1, 2)
- (6, 3) → (2, 1)

The dilated figure will have these points, smaller and similar in shape to the original.

Implication for the Graphs

- The dilated figure should be scaled down and positioned accordingly.
- The shape remains unchanged, just smaller.

Practical Applications of Dilation in Geometry

Real-World Examples

- Map Scaling: Reducing or enlarging maps for different views.
- Modeling: Creating smaller or larger models based on original designs.
- Computer Graphics: Zooming in or out on images or figures.

Importance in Mathematics Education

Understanding dilation helps students grasp the concepts of similarity, proportionality, and transformations, which are foundational in advanced geometry topics.

Summary and Final Tips

- Always verify the scale factor and ensure the figure's size is appropriately reduced.
- Confirm the position relative to the center of dilation.
- Remember that the shape is preserved; only size and position change.
- Use coordinate transformations to verify the expected shape and size.
- When analyzing multiple graphs, compare the size and position of the figures carefully.

Conclusion: Choosing the Correct Graph

To accurately identify the graph showing the result of dilating a figure by a factor of one-third:

- Look for a smaller, similar figure.
- Confirm the proportional reduction in size.
- Check the position relative to the dilation center.
- Use coordinate calculations if necessary.

Mastering this process enhances understanding of geometric transformations and prepares students for more advanced topics in mathematics.

Remember: The key to solving such problems is understanding the principles of dilation, carefully analyzing the figures, and verifying that the scaled figure matches the expected size and position based on the scale factor.

Frequently Asked Questions

What does it mean to dilate a figure by a factor of one-third?

Dilating a figure by a factor of one-third means shrinking the original figure to a size that is one-third of its original dimensions, both horizontally and vertically.

How can I identify the graph that shows a dilation by a factor of one-third?

Look for the graph where the figure appears uniformly smaller, with all sides scaled down to approximately one-third of the original size, maintaining the shape's proportions.

What are common mistakes when identifying a dilation by

one-third in a graph?

Common mistakes include confusing translation or shifts with dilation, or selecting a graph where the figure is larger or scaled incorrectly instead of smaller.

Does the position of the figure change after dilation by one-third?

It depends on the center of dilation; if the dilation is centered at a point within or outside the figure, the position may shift, but the size will be scaled down by one-third.

Can the dilation by one-third be applied around any point?

Yes, dilation can be performed around any point, but the resulting size and position depend on the chosen center of dilation.

Why is it important to understand dilation when analyzing graphs?

Understanding dilation helps in comprehending how figures can be scaled and transformed, which is essential in geometry, design, and real-world applications like engineering.

What tools can help me visualize the dilation of a figure by one-third?

Graphing software, geometric drawing tools, or physical models with rulers and compasses can help visualize and confirm the effects of dilation.

How do I verify if a graph correctly shows the dilation by one-third?

Compare the original figure and the dilated figure by measuring corresponding sides; the dilated figure should have sides approximately one-third the length of the original, maintaining the same shape.

Additional Resources

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Introduction: Understanding Geometric Dilation

In the realm of geometry, transformations such as translations, rotations, reflections, and dilations are fundamental concepts that help us understand how figures can be manipulated in the coordinate plane. Among these, dilation—also known as scaling—is a transformation that enlarges or reduces a figure relative to a fixed point called the center of dilation. The key aspect of dilation is the scale factor, which determines the degree of enlargement or reduction.

This article aims to explore the concept of dilation, particularly focusing on the effect of dilating a figure by a factor of one-third. We will analyze how this transformation alters the size and position of the original figure and how to interpret graphical representations of such a dilation. By the end, readers should be able to identify which graph correctly depicts this transformation, supported by detailed explanations.

Understanding Dilation and Scale Factors

What Is a Dilation?

Dilation is a transformation that produces a similar figure, scaled either larger or smaller, depending on the scale factor. Unlike other transformations, dilation preserves the shape and the angles of the figure but changes its size proportionally.

Key components of dilation include:

- Center of Dilation: The fixed point in the plane about which the figure is expanded or contracted.
- Scale Factor (k): A positive real number indicating the degree of dilation.

Effect of the Scale Factor

- If $k > 1$, the figure enlarges, becoming larger than the original.
- If $0 < k < 1$, the figure reduces in size, becoming smaller.
- If $k = 1$, the figure remains unchanged.
- If $k < 0$, the figure is reflected across the center and scaled accordingly (though negative scale factors are less common in basic geometry problems).

In our case, the scale factor is one-third ($k = 1/3$), indicating that the figure will shrink to one-third of its original size, maintaining its shape and proportions.

Mathematical Explanation of Dilation by a Factor of One-Third

Coordinate Transformation Rules

Suppose the original figure has vertices at points (x, y). When dilated by a scale factor of $\frac{1}{3}$ about a point (x_c, y_c), the new coordinates (x', y') are given by:

$$
x' = x_c + \frac{1}{3}(x - x_c)
$$
$$
y' = y_c + \frac{1}{3}(y - y_c)
$$

This formula indicates that each point moves closer to the center of dilation by a factor of $\frac{1}{3}$. The original points are scaled down, and their relative positions to the center of dilation are proportionally reduced.

Implications for Graphical Representation

- The dilated figure will be similar to the original, with all sides scaled down to one-third.
- The figure's shape remains unchanged.
- The position of the figure depends on the center of dilation; if the center is at the origin, the entire figure shrinks uniformly toward (0,0). If the center is elsewhere, the figure shrinks toward that point.

Interpreting Graphs of Dilation by One-Third

Common Features in the Correct Graph

When examining graphs to identify the figure resulting from a dilation by a factor of $\frac{1}{3}$, look for:

- Size Reduction: The figure should be noticeably smaller than the original.
- Preservation of Shape: All angles should remain the same; only the size changes.
- Relative Position: The figure's position depends on the center of dilation; if the center is at a vertex or the centroid, the figure shrinks toward that point.
- Scaling of Coordinates: For figures with known vertices, their coordinates should be approximately

one-third of the original's relative to the center of dilation.

Distinguishing the Correct Graph from Others

Incorrect graphs may show:

- The figure enlarged (scale factor > 1).
- A different shape or distorted figure.
- A shift that does not correspond to a dilation centered at the specified point.
- No change in size, indicating no dilation.

Step-by-Step Approach to Identify the Correct Graph

Step 1: Determine the Original Figure and Its Coordinates

If available, note the vertices of the original figure. For example, suppose the original triangle has vertices at $(3, 6)$, $(6, 9)$, and $(9, 6)$.

Step 2: Identify the Center of Dilation

- Often, the problem specifies or implies a center; common choices include the origin $(0,0)$, centroid, or a specific point.
- If the center is at the origin, the scaled figure's vertices will be at one-third the distance from the origin compared to the original.

Step 3: Calculate the Expected Coordinates of the Dilated Figure

Using the formula:

$$
x' = x_c + \frac{1}{3}(x - x_c)
$$
$$
y' = y_c + \frac{1}{3}(y - y_c)
$$

For each vertex, compute the new coordinates. For example, if the center is at $(0, 0)$:

- Original point: $(3, 6)$
- Dilated point: $\left(\frac{1}{3} \times 3, \frac{1}{3} \times 6 \right) = (1, 2)$

Similarly, compute for other vertices.

Step 4: Match Calculated Coordinates to Graphs

Compare the expected vertices with the depicted figures in the graphs. The correct graph should show the figure scaled down proportionally, with each vertex approximately at one-third of the original distances from the center.

Step 5: Confirm Shape and Position

Ensure the shape's angles are preserved and that the figure is correctly positioned relative to the center of dilation.

Practical Example and Analysis

Let's consider an example with specific figures:

- Original figure: a triangle with vertices at $(3, 4)$, $(6, 8)$, and $(9, 4)$.
- Center of dilation: $(0, 0)$.

Expected vertices after dilation by $\frac{1}{3}$:

- $(3, 4) \to (1, \frac{4}{3})$
- $(6, 8) \to (2, \frac{8}{3})$
- $(9, 4) \to (3, \frac{4}{3})$

In the graph options:

- The figure that appears with vertices approximately at these scaled points, maintaining the same shape, is the correct representation.
- Any other figure that is larger, shifted, or distorted does not depict the dilation by $\frac{1}{3}$.

Conclusion: Choosing the Correct Graph

Identifying which graph shows the result of dilating a figure by a factor of one-third involves understanding the properties of dilation, calculating expected scaled coordinates, and comparing

these to the options provided. It is crucial to:

- Recognize that the figure should be smaller but similar to the original.
- Confirm that the shape's angles are preserved.
- Ensure the figure's position aligns with the center of dilation.

By applying these principles systematically, one can confidently select the correct graph that accurately depicts a dilation by a factor of $\frac{1}{3}$.

Final Remarks: Tips for Success

- Always identify the center of dilation before analyzing the figure.
- Use coordinate geometry to verify the size and position of the scaled figure.
- Remember that dilation preserves shape and angles; only size and position change.
- Be cautious of graphs that show enlarged figures or distorted shapes—they do not represent a reduction by $\frac{1}{3}$.

Understanding these concepts will not only help in answering the current question but also strengthen overall geometric reasoning skills, essential for tackling similar problems confidently.

In summary, the key to determining the correct graph lies in recognizing the proportional reduction in size consistent with a scale factor of $\frac{1}{3}$, confirming the preservation of shape, and verifying the figure's position relative to the specified center of dilation.

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