

The Width Of A Rectangle Is $7x-7$ Feet And The Length Is $4x+9$ Feet , What Is The Perimeter Of The Rectangle??

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Understanding the dimensions of a rectangle is fundamental in geometry, especially when dealing with algebraic expressions that define its sides. In this article, we will explore how to determine the perimeter of a rectangle when its width and length are expressed in terms of a variable, specifically focusing on the given expressions: width as $7x - 7$ feet and length as $4x + 9$ feet. We will break down the problem step-by-step, providing detailed explanations, formulas, and examples to help you grasp this concept thoroughly.

Introduction to Rectangle Dimensions and Perimeter

A rectangle is a four-sided polygon with opposite sides equal and all angles right angles. The key dimensions of a rectangle are:

- Width (or breadth): The shorter side, often referred to as the "width."
- Length: The longer side.

The perimeter of a rectangle is the total distance around the rectangle, calculated as the sum of all four sides. Since opposite sides are equal, the perimeter formula simplifies to:

$$\text{Perimeter} = 2 \times (\text{Length} + \text{Width})$$

When the dimensions are expressed algebraically, as in the problem at hand, the perimeter becomes a function of the variable x .

Understanding the Given Expressions

The problem states:

- Width = $7x - 7$ feet
- Length = $4x + 9$ feet

These expressions involve a variable x , which can represent any real number that satisfies certain conditions (such as making the dimensions positive). Our goal is to find the perimeter in terms of x , which will give us an algebraic expression for the perimeter.

Key Points to Consider

- The value of x must be such that both dimensions are positive, i.e., $7x - 7 > 0$ and $4x + 9 > 0$.
- Once the dimensions are confirmed to be positive, we can proceed to calculate the perimeter.

Step-by-Step Calculation of the Perimeter

Let's now proceed to compute the perimeter systematically.

1. Write the Perimeter Formula

Perimeter (P) of a rectangle:

$$P = 2 \times (\text{Length} + \text{Width})$$

Substitute the given expressions:

$$P = 2 \times [(4x + 9) + (7x - 7)]$$

2. Simplify the Expression Inside the Brackets

Combine like terms:

$$(4x + 9) + (7x - 7) = 4x + 7x + 9 - 7 = (4x + 7x) + (9 - 7) = 11x + 2$$

So, the perimeter becomes:

$$P = 2 \times (11x + 2)$$

3. Expand the Expression

Distribute the 2:

$$\backslash[P = 2 \times 11x + 2 \times 2 = 22x + 4 \backslash]$$

Thus, the algebraic expression for the perimeter in terms of x is:

$$\backslash[\boxed{P = 22x + 4} \backslash]$$

Interpreting the Result and Finding Numerical Values

The perimeter depends on the value of x . To find specific numerical perimeter values, we need to determine suitable values of x that satisfy the positivity constraints.

1. Conditions for x

- Width > 0 :

$$\backslash[7x - 7 > 0 \rightarrow 7x > 7 \rightarrow x > 1 \backslash]$$

- Length > 0 :

$$\backslash[4x + 9 > 0 \rightarrow 4x > -9 \rightarrow x > -\frac{9}{4} \backslash]$$

Since x must satisfy both, the more restrictive condition is:

$$\backslash[x > 1 \backslash]$$

Therefore, for the rectangle to have positive dimensions, x must be greater than 1.

2. Example Calculation for $x > 1$

Suppose $x = 2$:

- Width = $7(2) - 7 = 14 - 7 = 7$ feet

- Length = $4(2) + 9 = 8 + 9 = 17$ feet

Perimeter:

$$[P = 22(2) + 4 = 44 + 4 = 48 \text{ feet}]$$

Similarly, for $x = 3$:

- Width = $7(3) - 7 = 21 - 7 = 14$ feet
- Length = $4(3) + 9 = 12 + 9 = 21$ feet

Perimeter:

$$[P = 22(3) + 4 = 66 + 4 = 70 \text{ feet}]$$

This illustrates how the perimeter increases as x increases.

Real-World Applications and Relevance

Understanding how to compute the perimeter of a rectangle with variable dimensions has numerous practical applications:

- Construction and Architecture: Estimating fencing or border material needed when dimensions depend on design variables.
- Manufacturing: Calculating materials for products where sizes vary based on customer specifications.
- Agriculture: Determining the amount of fencing or boundary material required for fields of variable sizes.
- Education: Developing algebra skills by relating geometric measurements to algebraic expressions.

Additional Considerations and Tips

- Always verify that the dimensions are positive before calculating the perimeter.
- When given dimensions as algebraic expressions, simplify inside the parentheses first.
- Remember that the perimeter formula for rectangles is straightforward once the dimensions are known.
- For more complex problems, consider graphing the perimeter function to visualize how it changes with x .

Summary

- The width of the rectangle is given as $(7x - 7)$ feet.

- The length of the rectangle is given as $(4x + 9)$ feet.
- The perimeter is calculated using $P = 2 \times (\text{Length} + \text{Width})$.
- Substituting the expressions, the perimeter simplifies to $P = 22x + 4$.
- For the rectangle to be valid (with positive dimensions), $x > 1$.
- Depending on the value of x , the perimeter varies and can be calculated directly.

By understanding these steps, you can solve similar algebraic geometry problems involving rectangles and other polygons, enhancing both your mathematical reasoning and problem-solving skills.

Conclusion

Determining the perimeter of a rectangle with variable dimensions involves understanding algebraic expressions, simplifying formulas, and ensuring the dimensions are valid. The key takeaway from this problem is that once the expressions for the width and length are known, the perimeter can be expressed as a linear function of x , specifically $P = 22x + 4$. Always check the constraints on x to ensure the physical feasibility of the dimensions. This approach is fundamental in both academic settings and real-world applications, where measurements depend on varying parameters.

If you want to practice further, try substituting different values of x (greater than 1) into the perimeter formula to see how the perimeter changes. This will deepen your understanding of the relationship between algebraic expressions and geometric measurements.

Frequently Asked Questions

What is the formula to find the perimeter of a rectangle?

The perimeter of a rectangle is calculated using the formula: $\text{Perimeter} = 2 \times (\text{Length} + \text{Width})$.

Given the width as $7x - 7$ feet and the length as $4x + 9$ feet, how do you express the perimeter in terms of x ?

$\text{Perimeter} = 2 \times [(7x - 7) + (4x + 9)] = 2 \times (11x + 2) = 22x + 4$ feet.

How do you find the value of x if the perimeter of the rectangle is given as 78 feet?

Set $22x + 4 = 78$ and solve for x : $22x = 74$, so $x = 74 \div 22 = 3.36$ (approximately).

What are the expressions for the width and length of the rectangle in terms of x ?

Width = $7x - 7$ feet, Length = $4x + 9$ feet.

How can you verify the perimeter calculation for a specific value of x ?

Substitute the value of x into the expressions for width and length, compute their sum, and multiply by 2 to find the perimeter, then compare to the expected value.

Additional Resources

The Width Of A Rectangle Is $7x-7$ Feet And The Length Is $4x+9$ Feet, What Is The Perimeter Of The Rectangle?

The question of calculating the perimeter of a rectangle when given algebraic expressions for its dimensions is a fundamental concept in geometry that combines basic algebra with geometric principles. This problem not only tests one's understanding of the perimeter formula but also emphasizes the importance of algebraic manipulation, substitution, and interpretation of variables within geometric contexts. In this article, we will explore the problem in detail, breaking down each component, providing comprehensive explanations, and analyzing the steps necessary to arrive at a correct and meaningful solution.

Understanding the Problem: Dimensions of the Rectangle

Before delving into calculations, it is essential to comprehend what the problem is presenting. The rectangle's width and length are expressed as algebraic expressions involving a variable, x :

- Width: $7x - 7$ feet
- Length: $4x + 9$ feet

This approach is typical in algebraic geometry, where the dimensions are not fixed but vary depending on the value of x . Such expressions can represent real-world scenarios where dimensions change in relation to certain parameters, making the problem more dynamic and applicable to variable conditions.

Key Points:

- The expressions involve linear algebraic functions of x .
- The value of x impacts the size of the rectangle.

- To find the perimeter, we need to understand how these expressions relate to the dimensions for different x values.

Fundamentals of Perimeter Calculation for Rectangles

The perimeter of a rectangle is a straightforward concept in geometry, defined as the total length around the rectangle. The standard formula is:

$$\text{Perimeter (P)} = 2 \times (\text{Length} + \text{Width})$$

This formula stems from the fact that a rectangle has two pairs of equal sides, and adding all sides results in twice the sum of a single length and width.

Application of the Formula:

- Using the given expressions for length and width, the perimeter becomes:

$$\backslash [P = 2 \times [(4x + 9) + (7x - 7)] \backslash]$$

- Simplify the expression inside the brackets before multiplying by 2.

Understanding this formula is crucial because it forms the basis for translating algebraic expressions into a numerical or variable-dependent perimeter.

Step-by-Step Calculation of the Perimeter

Let's perform the calculation systematically:

Step 1: Add the Length and Width Expressions

$$\backslash [(4x + 9) + (7x - 7) = 4x + 9 + 7x - 7 \backslash]$$

Combine like terms:

$$\begin{aligned} & \backslash[\\ & (4x + 7x) + (9 - 7) = 11x + 2 \\ & \backslash] \end{aligned}$$

Step 2: Multiply the Sum by 2

$$\begin{aligned} & \backslash[\\ & P = 2 \times (11x + 2) = 2 \times 11x + 2 \times 2 = 22x + 4 \\ & \backslash] \end{aligned}$$

Result:

$$\begin{aligned} & \backslash[\\ & \boxed{ \\ & \text{Perimeter} = 22x + 4 \text{ feet} \\ & } \\ & \backslash] \end{aligned}$$

This expression indicates how the perimeter depends on the variable x . Without specific constraints or a value for x , the perimeter remains expressed algebraically.

Interpreting the Variable x and Practical Implications

In real-world contexts, understanding the variable x is essential:

- What does x represent?

It could symbolize a design parameter, a scale factor, or a variable quantity that influences the dimensions of the rectangle.

- Constraints on x :

Since dimensions cannot be negative in a real-world scenario, both width and length expressions must be positive:

$$\begin{aligned} & \backslash[\\ & 7x - 7 > 0 \rightarrow x > 1 \\ & \backslash[\\ & 4x + 9 > 0 \rightarrow x > -\frac{9}{4} \\ & \backslash] \end{aligned}$$

The more restrictive of these is $(x > 1)$, since it ensures both dimensions are positive.

- Implication for the perimeter:

As x increases beyond 1, the perimeter increases linearly, emphasizing the importance of understanding the domain of x for practical applications.

Special Cases and Numerical Examples

To gain a clearer picture, consider specific values of x within the permissible domain:

Case 1: $(x = 2)$

- Width: $(7(2) - 7 = 14 - 7 = 7)$ feet
- Length: $(4(2) + 9 = 8 + 9 = 17)$ feet
- Perimeter: $(2 \times (7 + 17) = 2 \times 24 = 48)$ feet

Case 2: $(x = 3)$

- Width: $(7(3) - 7 = 21 - 7 = 14)$ feet
- Length: $(4(3) + 9 = 12 + 9 = 21)$ feet
- Perimeter: $(2 \times (14 + 21) = 2 \times 35 = 70)$ feet

These examples illustrate how the perimeter scales with x , reinforcing the linear relationship derived earlier.

Broader Mathematical Context and Applications

The problem exemplifies a common scenario in algebra and geometry where variables are used to model real-world shapes and figures. The utility of such modeling extends into various fields:

- Architecture and Engineering:

Designing structures with dimensions that depend on certain parameters, allowing for flexible scaling.

- Mathematics Education:

Teaching students how algebraic expressions relate to geometric figures, fostering understanding of

variable relationships.

- Optimization Problems:

Determining the value of x that maximizes or minimizes the perimeter for design efficiency.

- Computer-Aided Design (CAD):

Algorithms that adjust dimensions based on user input or constraints.

Understanding how to manipulate algebraic expressions to compute perimeters is a foundational skill that bridges pure mathematics and practical application.

Conclusion: Summarizing the Key Insights

The calculation of the perimeter of a rectangle with algebraically expressed dimensions underscores the importance of algebraic manipulation and understanding geometric formulas. The key takeaways include:

- The perimeter formula for a rectangle: $P = 2(L + W)$.
- Substituting the given expressions: $P = 2[(4x + 9) + (7x - 7)]$.
- Simplifying to obtain a linear expression: $P = 22x + 4$.
- Recognizing the significance of variable constraints for realistic scenarios.
- Appreciating the broader applications of such mathematical models across various disciplines.

By carefully analyzing each step and understanding the relationships involved, students and professionals alike can confidently approach similar problems, fostering a deeper comprehension of the interplay between algebra and geometry. This problem exemplifies how mathematical expressions serve as powerful tools to model, analyze, and solve real-world challenges involving shapes and dimensions.

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