

The Perimeter Of A Rectangle Is $15x + 17y$ If The Length Is $x + 7y$ Then Find The Width Of The Rectangle.

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Understanding the properties and formulas related to rectangles is fundamental in geometry, especially when dealing with algebraic expressions involving variables. In this article, we will explore how to determine the width of a rectangle when given its perimeter and length expressed in algebraic terms. This problem involves applying the perimeter formula of a rectangle and algebraic manipulation to solve for the unknown width.

Understanding the Perimeter of a Rectangle

What Is the Perimeter?

The perimeter of a rectangle is the total distance around the figure. It is calculated by summing the lengths of all four sides. In a rectangle, opposite sides are equal in length, which simplifies the perimeter calculation.

Perimeter Formula of a Rectangle

The standard formula for the perimeter (P) of a rectangle is:

$$P = 2(\text{length} + \text{width})$$

where:

- Length (L) is the longer side of the rectangle.
- Width (W) is the shorter side.

When the length and width are expressed algebraically, the perimeter becomes a function of variables, often involving expressions like $15x + 17y$.

Given Data and Problem Statement

The problem provides the following information:

- Perimeter of the rectangle: $P = 15x + 17y$
- Length of the rectangle: $L = x + 7y$

Our goal:

- Find the width W of the rectangle in terms of variables x and y .

This problem involves algebraic expressions and requires applying the perimeter formula, substituting the known length, and solving for the width.

Step-by-Step Solution Approach

1. Recall the Perimeter Formula

$$P = 2 \times (L + W)$$

Given that:

- $P = 15x + 17y$
- $L = x + 7y$

We can substitute these values into the perimeter formula to find W .

2. Set Up the Equation

$$15x + 17y = 2 \times [(x + 7y) + W]$$

This is an algebraic equation with the unknown W .

3. Simplify the Equation

Distribute the 2 on the right side:

$$15x + 17y = 2x + 14y + 2W$$

Now, to isolate W , move all known terms to one side:

$$15x + 17y - 2x - 14y = 2W$$

Simplify the left side:

$$\begin{aligned} & (15x - 2x) + (17y - 14y) = 2W \\ & 13x + 3y = 2W \end{aligned}$$

4. Solve for the Width (W)

Divide both sides of the equation by 2:

$$W = \frac{13x + 3y}{2}$$

This expression represents the width of the rectangle in terms of variables (x) and (y) .

Final Expression for the Width of the Rectangle

$$\boxed{W = \frac{13x + 3y}{2}}$$

This formula provides a direct way to compute the width given specific values of (x) and (y) .

Interpreting the Result

The derived expression shows that the width is dependent on the variables (x) and (y) . To find a numerical value for the width, you need specific values of these variables.

Example:

Suppose:

$$- (x = 2)$$

$$- (y = 3)$$

Substitute into the expression:

$$\begin{aligned} & W = \frac{13(2) + 3(3)}{2} = \frac{26 + 9}{2} = \frac{35}{2} = 17.5 \end{aligned}$$

So, the width of the rectangle would be 17.5 units.

Additional Considerations and Real-World Applications

Practical Applications of the Formula

Understanding how to manipulate algebraic expressions for geometric figures has numerous real-world applications, including:

- Architecture and construction planning.
- Design of rectangles in manufacturing.
- Space optimization in layouts.

Constraints and Validity

- The values of x and y should be chosen such that the width W remains positive.
- The variables x and y could represent different parameters depending on context, such as dimensions, scaling factors, or other quantities.

Summary and Key Takeaways

- The perimeter of a rectangle can be expressed algebraically as $P = 2(L + W)$.
- Given the perimeter $15x + 17y$ and length $x + 7y$, we can derive the width W using algebraic substitution.
- The final formula for the width is:

$$W = \frac{13x + 3y}{2}$$

- To find the numerical value of W , specific values of x and y are needed.

Conclusion

Understanding the relationship between the perimeter, length, and width of a rectangle is essential in solving geometry problems involving algebraic expressions. By applying the perimeter formula and algebraic manipulation, we obtained a clear formula for the width of the rectangle based on the given parameters. This approach exemplifies the importance of combining geometric concepts with algebraic skills to solve real-world problems efficiently.

Remember, always verify the values of your variables to ensure the dimensions make sense in the context of the problem, and practice applying these methods to a variety of similar problems for mastery.

Frequently Asked Questions

What is the formula for the perimeter of a rectangle in terms of length and width?

The perimeter of a rectangle is given by $P = 2(\text{length} + \text{width})$.

Given the perimeter of a rectangle as $15x + 17y$ and the length as $x + 7y$, how do you find the width?

Subtract the length from half the perimeter: $\text{Width} = (15x + 17y) / 2 - (x + 7y)$.

How do you simplify the expression for the width of the rectangle in this problem?

Simplify by dividing the perimeter by 2 and then subtracting the length: $\text{Width} = (15x + 17y)/2 - (x + 7y)$.

What is the step-by-step process to find the width of the rectangle given the perimeter and length?

First, divide the perimeter by 2 to get the sum of length and width. Then, subtract the length ($x + 7y$) from this sum to find the width.

If $x=2$ and $y=3$, what is the numerical value of the width of the rectangle?

First, find the perimeter: $15(2) + 17(3) = 30 + 51 = 81$. Half of that is 40.5. Length: $2 + 7(3) = 2 + 21 = 23$. Width: $40.5 - 23 = 17.5$.

Why is it important to understand the relationship between perimeter, length, and width in algebraic expressions?

Understanding this relationship helps in solving for unknown dimensions and applying algebraic methods to geometric problems effectively.

Additional Resources

The Perimeter Of A Rectangle Is $15x + 17y$. If The Length Is $x + 7y$, Then Find The Width Of The

Rectangle. This problem encapsulates fundamental concepts of algebra and geometry, making it a critical exercise for students mastering the basics of shape properties and algebraic expressions. It combines understanding of perimeter formulas with the algebraic manipulation needed to find missing dimensions, providing an excellent opportunity to reinforce problem-solving skills. In this article, we will explore the problem in detail, break down the key concepts involved, and offer a comprehensive solution approach, along with a review of related learning points.

Understanding the Problem Statement

At its core, the problem involves a rectangle with a given perimeter expressed as an algebraic expression: $15x + 17y$. The length of the rectangle is provided as $X + 7y$, and the task is to find its width.

This problem is typical in algebra-focused geometry questions where the dimensions of a shape are expressed using algebraic expressions rather than fixed numerical values. The challenge lies in translating the given algebraic perimeter into a workable equation and then solving for the unknown width.

Key Concepts Involved

Before delving into the solution, it's essential to review the fundamental concepts involved:

1. Perimeter of a Rectangle

- The perimeter (P) of a rectangle is the total distance around the shape.
- It is calculated using the formula: $P = 2(\text{length} + \text{width})$.

2. Algebraic Expressions

- Variables (x and y) represent unknown quantities or parameters.
- Expressions such as $X + 7y$ or $15x + 17y$ combine constants and variables.

3. Solving for an Unknown

- The process involves setting up an algebraic equation based on the given information and solving for the variable of interest (width).
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Step-by-Step Solution Approach

Let's now analyze the problem carefully and approach a solution systematically.

Step 1: Identify Known and Unknown Quantities

- Perimeter, $P = 15x + 17y$
- Length, $L = x + 7y$
- Width, $W = ?$

Our goal: Find W .

Step 2: Write the Perimeter Formula

Recall that for a rectangle:

$$P = 2(L + W)$$

Substitute the known expressions:

$$15x + 17y = 2[(x + 7y) + W]$$

Step 3: Expand and Rearrange

Distribute the 2:

$$15x + 17y = 2x + 14y + 2W$$

Now, isolate W :

$$15x + 17y - 2x - 14y = 2W$$

Simplify:

$$(15x - 2x) + (17y - 14y) = 2W$$

$$13x + 3y = 2W$$

Finally, solve for W :

$$W = \frac{13x + 3y}{2}$$

Result:

$$\boxed{W = \frac{13x + 3y}{2}}$$

This is the expression for the width of the rectangle in terms of x and y .

Interpreting the Result

The width of the rectangle depends on the values of x and y , which are parameters in the problem. Without specific numerical values for x and y , the width remains expressed algebraically as above.

This highlights a critical aspect of algebra: often, problems involve variables, and solutions are expressed in terms of these variables unless additional information is provided.

Additional Considerations and Variations

While the above solution addresses the problem as stated, it's worth exploring related aspects:

1. Special Cases

- If specific values for x and y are given, substituting them into the expression will yield a numerical value for W .
- For example, if $x=2$ and $y=3$:

$$W = \frac{13(2) + 3(3)}{2} = \frac{26 + 9}{2} = \frac{35}{2} = 17.5$$

So, the width would be 17.5 units in that case.

2. Constraints on Variables

- The problem does not specify any constraints on x and y .
- In real-world scenarios, negative or zero values for x or y might be invalid for dimensions, so additional conditions might be needed.

3. Extending the Problem

- If asked to find the perimeter given specific dimensions, reverse calculations can be performed.
- Alternatively, if the width is provided, one could find the perimeter or the other dimension.

Pros and Cons of the Approach

Pros:

- Demonstrates clear application of algebraic formulas in geometric contexts.

- Reinforces the importance of translating word problems into algebraic equations.
- Allows for flexible substitution of variables to find specific solutions.

Cons:

- The solution remains in algebraic form without specific numerical values for x and y .
- The problem might seem abstract for beginners unfamiliar with expressing dimensions algebraically.
- Additional constraints or information are often needed for practical applications.

Features and Educational Value

- Concept Reinforcement: Reinforces the formula for perimeter and how to manipulate algebraic expressions.
- Problem-Solving Skills: Encourages systematic approach in solving for unknowns.
- Real-World Relevance: Demonstrates how algebra can model geometric problems involving variables.
- Flexibility: The method can be adapted to similar problems with different expressions.

Conclusion

The problem involving the perimeter of a rectangle expressed as $15x + 17y$ and the length as $x + 7y$ provides a practical example of combining algebra and geometry. Through systematic application of the perimeter formula and algebraic manipulation, we derive the expression for the width as $(13x + 3y)/2$. This exercise underscores the importance of understanding variable expressions, translating word problems into equations, and solving for unknown dimensions. Whether for academic practice or real-world modeling, mastering such problems enhances both conceptual understanding and problem-solving prowess in mathematics.

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