Stanley Is Building A Rectangular Fence With 44 Feet Of Fencing. If The Width Is Two Less Than Half The

Stanley Is Building A Rectangular Fence With 44 Feet Of Fencing. If The Width Is Two Less Than Half The length, how can he determine the dimensions of his fence? This problem involves understanding algebraic expressions, setting up equations, and applying basic geometric principles to find the solution. In this article, we will explore how to approach such a problem step-by-step, ensuring clarity and thoroughness for learners and enthusiasts alike.

Understanding the Problem

Before diving into calculations, it's essential to comprehend what the problem is asking. Here are the key points:

- Stanley has a total of 44 feet of fencing to build a rectangular fence.
- The width of the rectangle is related to its length by the statement: "If the width is two less than half the length."

This phrase indicates a relationship between width and length, which we need to translate into an algebraic expression.

Defining Variables

To formulate the problem mathematically, assign variables:

- Let L represent the length of the rectangle.
- Let W represent the width of the rectangle.

According to the problem:

- The width W is two less than half the length L.

Expressed algebraically:

$$ W = \frac{1}{2}L - 2 $$

Having defined the variables, we can now use the given total fencing length to set up an equation.

Setting Up the Equation

The total fencing used for a rectangular fence is the perimeter. The perimeter P of a rectangle is:

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

Given that the total fencing is 44 feet:

$$ 2(L + W) = 44 $$

Substitute the expression for W into the perimeter equation:

$$ 2 \left(L + \left(\frac{1}{2}L - 2 \right) \right) = 44 $$

Simplify:

$$ 2 \left(L + \frac{1}{2}L - 2 \right) = 44 $$

Combine like terms inside the parentheses:

$$ 2 \left(\frac{3}{2}L - 2 \right) = 44 $$

Distribute the 2:

$$ 2 \times \frac{3}{2}L - 2 \times 2 = 44 $$

$$ 3L - 4 = 44 $$

Now, solve for L:

$$ 3L = 44 + 4 $$

$$ 3L = 48 $$

$$ L = \frac{48}{3} $$

$$ L = 16 $$

With L known, find W:

$$ W = \frac{1}{2} \times 16 - 2 $$

$$ W = 8 - 2 $$

$$ W = 6 $$

Result: The length of the fence is 16 feet, and the width is 6 feet.

Verifying the Solution

It's good practice to verify the solution by checking the total perimeter:

$$ P = 2(L + W) = 2(16 + 6) = 2 \times 22 = 44 $$

The total fencing matches the given amount, confirming that the solution is correct.

Interpreting the Dimensions

The dimensions of Stanley's fence are:

- Length: 16 feet
- Width: 6 feet

This rectangular fence will enclose an area of:

$$ \text{Area} = L \times W = 16 \times 6 = 96 \text{ square feet} $$

Knowing the area can help Stanley assess whether the size meets his needs.

Additional Considerations and Variations

While this problem deals with a specific relationship between width and length, similar problems can vary based on different conditions. Here are some common variations:

1. Different Relationships Between Dimensions

- Width is equal to half the length plus a certain number.
- The perimeter is a different value.
- The dimensions are constrained by other factors such as maximum or minimum sizes.

2. Using the Perimeter Formula for Other Shapes

- For irregular shapes, perimeter calculations become more complex.
- For circular fences, the circumference formula applies: $C = 2\pi r$.

3. Applying Algebra in Real-Life Scenarios

- Planning fencing for a garden.

- Designing enclosures for animals.
- Estimating materials for construction projects.

Practical Tips for Solving Similar Problems

- Identify variables: Clearly define what each variable represents.
- Translate words into equations: Carefully convert descriptive relationships into algebraic expressions.
- Set up equations based on known formulas: Use relevant formulas like perimeter, area, volume.
- Solve systematically: Simplify equations step-by-step, checking calculations.
- Verify solutions: Plug back into original equations to confirm correctness.
- Consider real-world constraints: Ensure that solutions are practical and feasible.

Conclusion

Building a rectangular fence with a fixed amount of fencing involves understanding the relationship between dimensions, setting up appropriate equations, and solving for unknowns. In Stanley's case, knowing that the width is two less than half the length allowed us to form an algebraic equation that led to straightforward calculations. Such problems highlight the importance of algebra in everyday tasks and demonstrate how mathematical reasoning helps in planning and problem-solving.

By mastering these steps—defining variables, translating relationships into equations, solving systematically, and verifying results—you can confidently tackle similar problems involving geometry and algebra, whether for practical projects or academic exercises.

Frequently Asked Questions

What is the total length of fencing Stanley has?

Stanley has 44 feet of fencing in total.

If the width of the fence is two less than half the length, how can we express the width in terms of the length?

The width can be expressed as (1/2) times the length minus 2, or (L/2) - 2.

What is the formula for the perimeter of the rectangular fence?

The perimeter P = 2 times the length plus 2 times the width, or P = 2L + 2W.

How can we set up an equation to find the length of the fence?

Substitute W = (L/2) - 2 into the perimeter formula: 44 = 2L + 2[(L/2) - 2].

What is the simplified equation to solve for the length L?

Simplify: 44 = 2L + (L - 4) which simplifies to 44 = 3L - 4.

How do you solve for the length L using the simplified equation?

Add 4 to both sides: 48 = 3L, then divide both sides by 3: L = 16 feet.

What is the width of the fence based on the length found?

W = (L/2) - 2 = (16/2) - 2 = 8 - 2 = 6 feet.

Is the calculated width consistent with the fencing perimeter?

Yes, plugging back: perimeter = 2(16) + 2(6) = 32 + 12 = 44 feet, matching the fencing total.

What are the dimensions of the fence?

The length is 16 feet and the width is 6 feet.

Can this problem be generalized for different fencing lengths and relationships?

Yes, by setting up similar equations with variables for length and width based on given relationships, you can solve for various fencing scenarios.

Additional Resources

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Introduction

Mathematics often intersects with everyday activities, revealing how algebraic concepts underpin even simple tasks like fencing a backyard. Recently, an intriguing problem emerged involving Stanley, a homeowner eager to enclose a rectangular area with a limited amount of fencing. With only 44 feet of fencing available, Stanley aims to determine the dimensions of his rectangular fence based on a specific relationship between its length and width.

This problem is a classic example of how algebra can be applied to real-world scenarios, blending geometry with problem-solving skills. In this article, we explore the problem's details, analyze the mathematical relationships involved, and examine the broader implications of such problems in practical contexts.

The Core Problem Statement

Stanley's fencing project is constrained by the total length of fencing he possesses:

- Total fencing available: 44 feet
- Shape: Rectangular

The critical relationship given is:

> If the width is two less than half the length.

Mathematically, this can be expressed as:

$W = (1/2)L - 2$

Where:
- L = Length of the rectangle
- W = Width of the rectangle

The goal: Determine the dimensions (length and width) of the fence given this relationship and fencing constraint.

Understanding the Relationship Between Length and Width

Expressing the Dimensions

The key relationship:

$W = (1/2)L - 2$

This indicates that the width depends directly on the length, with a specific proportionality and offset. To analyze the problem effectively, it’s essential to understand how the perimeter relates to these dimensions.

The Perimeter Constraint

The perimeter P of a rectangle is calculated as:

$P = 2L + 2W$

Given that Stanley has 44 feet of fencing, the perimeter must satisfy:

$2L + 2W = 44$

Dividing both sides by 2 simplifies this to:

$L + W = 22$

This simplified relationship is crucial because it links the length and width directly, allowing us to substitute the expression for W into this equation.

Deriving the Dimensions: Step-by-Step

Step 1: Substitute the expression for W

From earlier:

$W = (1/2)L - 2$

Substituting into $L + W = 22$:

$L + (1/2)L - 2 = 22$

Step 2: Simplify and solve for L

Combine like terms:

$L + (1/2)L = 22 + 2$

$(1 + 0.5)L = 24$

$1.5L = 24$

Divide both sides by 1.5:

$L = 24 / 1.5 = 16$

Step 3: Find W using the expression

Now, substitute $L = 16$ into the expression for W:

$W = (1/2)(16) - 2 = 8 - 2 = 6$

Final Dimensions and Validation

The dimensions of Stanley's fence are:

- Length (L): 16 feet
- Width (W): 6 feet

To verify, check the perimeter:

$$P = 2L + 2W = 2(16) + 2(6) = 32 + 12 = 44 \text{ feet}$$

This confirms that the dimensions satisfy the fencing constraint and the relationship between width and length.

Broader Implications and Practical Considerations

Real-World Application

This problem demonstrates how algebraic relationships can be applied to practical tasks such as fencing, construction, or landscaping. By understanding the relationship between dimensions and constraints, homeowners and professionals can optimize materials and design.

Variations and Extensions

The problem can be extended or modified in various ways:

- Different fencing lengths: How do the dimensions change if the fencing length varies?
- Alternative relationships: What if the width is a different fraction or offset of the length?
- Different shapes: How would the problem change for other shapes like circles or triangles?

Educational Value

Such problems serve as excellent teaching tools for:

- Algebraic manipulation
- Applying formulas to real-world contexts
- Developing problem-solving skills

Key Takeaways

- The relationship between dimensions can be expressed algebraically and used to solve for unknowns.
- Constraints like total fencing length translate into equations that can be manipulated to find specific measurements.
- The problem illustrates the importance of substitution and solving systems of equations.

Conclusion

Stanley's fencing project, constrained by 44 feet of fencing and a specific relationship between width and length, exemplifies how basic algebra can inform practical decisions. By translating the verbal relationship into an algebraic equation and applying the perimeter constraint, we identified the dimensions of the fence as 16 feet in length and 6 feet in width. Understanding such problems enhances both mathematical literacy and practical problem-solving skills, underscoring the relevance of algebra in everyday life.

Whether for fencing, construction, or design, recognizing the interplay between constraints and dimensions allows for efficient planning and resource management. Stanley's project is a testament to how mathematical reasoning can lead to optimal and feasible solutions in real-world scenarios.

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