

Perimeter Of A Rectangle Is 80 M If One Of The Side Is 4 M Find The Area Of The Rectangle

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Understanding the properties of rectangles is fundamental in geometry, especially when it comes to calculating their dimensions and areas. In this article, we will explore how to find the area of a rectangle given its perimeter and one side length. Specifically, we will analyze the problem: Perimeter of a rectangle is 80 meters. If one of the sides is 4 meters, find the area of the rectangle. By breaking down this problem step-by-step, we aim to enhance your problem-solving skills and deepen your understanding of rectangle properties.

Understanding the Basics of Rectangles

Before diving into the specific problem, it is essential to understand the basic properties and formulas related to rectangles.

What is a Rectangle?

- A rectangle is a quadrilateral with four right angles.
- Opposite sides are equal in length.
- The opposite sides are parallel.

Key Properties of a Rectangle

- Length (L): The longer side.
- Breadth or Width (W): The shorter side.
- Perimeter (P): The total distance around the rectangle.
- Area (A): The space enclosed within the rectangle.

Formulas to Remember

- Perimeter of a rectangle: $P = 2 \times (L + W)$
- Area of a rectangle: $A = L \times W$

Analyzing the Given Problem

Let's restate the problem for clarity:

> The perimeter of a rectangle is 80 meters. If one of the sides is 4 meters, find the area of the rectangle.

This problem involves two key pieces of information:

1. The perimeter $(P = 80, \text{m})$
2. One side length, say $(W = 4, \text{m})$

The goal is to determine the rectangle's area, which requires knowing both sides: length and width.

Step-by-Step Solution Approach

To solve this problem systematically, follow these steps:

Step 1: Assign Variables

- Let the known side be $(W = 4, \text{m})$
- Let the unknown side be (L, m)

Step 2: Use the Perimeter Formula

Recall the perimeter formula:

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

Substitute the known perimeter and side:

$$80 = 2(L + 4)$$

Step 3: Solve for the Unknown Side (L)

Divide both sides by 2:

$$\frac{80}{2} = L + 4$$

$$40 = L + 4$$

Subtract 4 from both sides:

$$L = 40 - 4 = 36 \text{ m}$$

Step 4: Calculate the Area

Use the area formula:

$$A = L \times W$$

Substitute the known values:

$$A = 36 \times 4 = 144 \text{ m}^2$$

Thus, the area of the rectangle is 144 square meters.

Additional Explanation and Insights

Understanding the problem-solving process helps reinforce geometric concepts and enhances your mathematical intuition.

Why does the perimeter formula work here?

- Since a rectangle has two pairs of equal sides, the total boundary length (perimeter) is twice the sum of one length and one width.
- The known perimeter allows us to set up an equation to find the unknown side.

Alternative Scenarios

- If the problem provided different perimeter values or other side lengths, the same approach could be adapted accordingly.
- The key is to translate the given information into the standard formulas and solve for the unknowns.

Common Mistakes to Avoid

- Confusing the perimeter with the area.
- Using incorrect formulas.
- Forgetting to double the sum of sides when calculating perimeter.
- Mislabeling sides and mixing up which is length or width.

Practical Applications of the Concept

Understanding how to find the area of a rectangle when given its perimeter and one side length has numerous real-world applications:

1. Designing rectangular plots of land, where fencing (perimeter) and one side length are known.
2. Calculating the amount of material needed for flooring or wall coverings based on boundary measurements.
3. Planning rectangular garden beds with specific fencing and side dimensions.
4. Estimating the capacity or coverage area in construction projects.

Summary and Key Takeaways

- When given the perimeter and one side of a rectangle, you can find the other side using the perimeter formula.
- The perimeter formula for a rectangle is $P = 2 \times (L + W)$.
- Substituting known values allows solving for the unknown side.
- Once both sides are known, the area is found by multiplying length and width.
- In this particular problem, the rectangle has a length of 36 meters and a width of 4 meters, leading to an area of 144 square meters.
- Mastering these steps enhances problem-solving skills and prepares you for more complex geometric calculations.

Additional Practice Problems

To reinforce your understanding, try solving the following problems:

1. If the perimeter of a rectangle is 100 meters and one side is 20 meters, what is the area?
2. A rectangle has an area of 200 square meters and one side measures 10 meters. Find the length of the other side.
3. The perimeter of a rectangle is 60 meters. If the length is twice the width, find both dimensions and the area.

4. A fencing company needs to build a rectangular fence with a perimeter of 120 meters. If one side is 30 meters, what is the area enclosed?
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Conclusion

Understanding how to determine the area of a rectangle from its perimeter and known side length is a fundamental skill in geometry. By applying the formulas methodically and solving step-by-step, you can accurately find unknown dimensions and calculate the area. This knowledge is not only vital for academic purposes but also has practical applications in various fields such as architecture, landscaping, and construction. Keep practicing similar problems to strengthen your geometric problem-solving abilities and become confident in handling real-world measurement challenges.

Frequently Asked Questions

What is the formula for the perimeter of a rectangle?

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

Given the perimeter of a rectangle is 80 meters and one side is 4 meters, how do you find the other side?

Subtract twice the known side from the perimeter and divide the remainder by 2: $(80 - 2 \times 4) / 2 = (80 - 8) / 2 = 72 / 2 = 36$ meters.

What is the length of the unknown side of the rectangle in this problem?

The length of the unknown side is 36 meters.

How do you calculate the area of the rectangle once you have both sides?

Multiply the length by the width: $\text{Area} = \text{length} \times \text{width}$.

What is the area of the rectangle in this problem?

The area is $4 \text{ meters} \times 36 \text{ meters} = 144$ square meters.

Why is it important to understand the formula for perimeter and area in geometry?

Understanding these formulas helps solve real-world problems involving measurements and space, such as designing layouts or calculating materials needed.

Can the method used here be applied to find the area of any rectangle with known perimeter and one side?

Yes, by using the perimeter to find the unknown side and then multiplying the sides to find the area, this method applies to any rectangle with known perimeter and one side.

Additional Resources

Perimeter Of A Rectangle Is 80 M If One Of The Side Is 4 M Find The Area Of The Rectangle

Understanding the geometric properties of rectangles is fundamental in both academic contexts and real-world applications. The problem posed — "Perimeter of a rectangle is 80 meters if one of the sides is 4 meters, find the area" — encapsulates core concepts of geometry, algebra, and problem-solving techniques. This article offers a comprehensive exploration of this problem, dissecting its components, providing detailed solutions, and analyzing the underlying principles to foster a deeper understanding.

Introduction to Rectangles and Their Properties

What Is a Rectangle?

A rectangle is a four-sided polygon, or quadrilateral, characterized by having opposite sides equal in length and all interior angles measuring 90 degrees. Its shape is familiar in everyday life, from tables and screens to architectural layouts.

Key Properties of Rectangles:

- Opposite sides are equal in length.
- All interior angles are right angles (90 degrees).
- The diagonals bisect each other and are equal in length.
- The perimeter and area can be calculated using specific formulas based on side lengths.

Relevance of Perimeter and Area

- Perimeter measures the total length around the rectangle. It is vital in applications involving fencing, framing, or material estimation.
- Area quantifies the space enclosed within the rectangle, essential in land measurement, flooring, and space planning.

Decoding the Given Data

The problem states:

- The perimeter (P) of the rectangle is 80 meters.
- One side (say, length or width) is 4 meters.
- The goal: Find the area (A) of the rectangle.

This information provides a foundation to set up equations and derive the unknown side length and, subsequently, the area.

Step-by-Step Solution Approach

1. Understanding the Perimeter of a Rectangle

The perimeter (P) of a rectangle with sides (l) and (w) is given by:

$$P = 2(l + w)$$

Given that $(P = 80)$ meters, the equation becomes:

$$2(l + w) = 80$$

Dividing both sides by 2:

$$l + w = 40$$

This is a critical relationship, linking the length and width of the rectangle.

2. Incorporating the Known Side Length

One side is specified as 4 meters. Since the problem doesn't specify whether this is the length or width, the solution applies to either case, but typically, the side could be $(l = 4)$ meters or $(w = 4)$ meters.

Case A: The known side is the length ($l = 4$ meters).

Using the earlier relation:

$$l + w = 40$$

Substitute $(l = 4)$:

$$4 + w = 40$$

Solve for (w) :

$$w = 40 - 4 = 36 \text{ meters}$$

Case B: The known side is the width ($w = 4$ meters).

Similarly:

$$l + 4 = 40$$

Solve for (l) :

$$l = 40 - 4 = 36 \text{ meters}$$

In both cases, the other side is 36 meters, confirming the symmetry of the problem.

Calculating the Area of the Rectangle

Once the dimensions are known, calculating the area (A) becomes straightforward:

$$A = l \times w$$

Using Case A:

$$A = 4 \times 36 = 144 \text{ square meters}$$

Using Case B:

$$A = 36 \times 4 = 144 \text{ square meters}$$

Thus, regardless of which side is 4 meters, the area of the rectangle is 144 square meters.

Deeper Analysis and Mathematical Considerations

Why Is the Area the Same Regardless of Side Assignment?

The problem's symmetry illustrates a fundamental aspect of rectangles: the area depends on the product of the two sides, which are interchangeable in multiplication. When one side is fixed at 4 meters, the other side must be 36 meters to satisfy the perimeter constraint, resulting in the same area whether 4 meters is considered the length or the width.

Implications for Real-World Applications

This problem exemplifies how understanding the relationships between perimeter and side lengths can aid in designing spaces, estimating materials, and solving practical problems. For instance:

- Fencing: Knowing the total length of fencing needed (perimeter) and the dimensions of the enclosed area.
- Flooring and Tiling: Calculating the area to determine material requirements.
- Land Measurement: Planning plots of land based on boundary measurements.

Additional Considerations and Variations

What if the side is not 4 meters? How does that affect the area?

Suppose the side is a different length, say s meters, then:

$$l + w = 40$$

and if $l = s$:

$$w = 40 - s$$

The area becomes:

$$A = s(40 - s)$$

This quadratic relationship:

$$A(s) = 40s - s^2$$

has a maximum at the vertex of the parabola, which occurs at:

$$s = \frac{-b}{2a}$$

For this quadratic:

$$A(s) = -s^2 + 40s$$

$$a = -1$$

$$b = 40$$

Maximum area:

$$s = -\frac{40}{2 \times (-1)} = \frac{40}{2} = 20$$

Corresponding maximum area:

$$A_{\max} = 40 \times 20 - 20^2 = 800 - 400 = 400 \text{ square meters}$$

This insight is valuable in optimization problems, showing that a rectangle with a given perimeter maximizes area when the sides are equal (a square), resulting in sides of 20 meters each and an area of 400 square meters.

This variation highlights the importance of symmetry and optimization in geometric design.

Conclusion: Synthesis of Key Insights

The problem "Perimeter of a rectangle is 80 meters, one side is 4 meters, find the area" encapsulates essential geometric principles and problem-solving strategies. By translating the given information into algebraic equations, we deduce the unknown side length, leading to the calculation of the area. The process underscores the importance of understanding relationships between perimeter, side lengths, and area, which are fundamental in both theoretical mathematics and practical applications.

Key takeaways include:

- The perimeter formula $P = 2(l + w)$ is crucial for relating side lengths.
- When one side is known, the other can be immediately deduced.
- The area is simply the product of the two sides.
- The problem illustrates symmetry and the potential for optimization, as maximum area occurs when the rectangle becomes a square.

This exploration not only solves a specific problem but also reinforces broader concepts that are applicable in architecture, engineering, and everyday problem-solving. Mastery of these foundational principles enhances analytical thinking and mathematical proficiency, vital skills in an increasingly quantitative world.

In summary, understanding the relationships within rectangles, applying algebraic techniques, and recognizing the broader implications of these geometric principles are essential for both educational growth and practical problem-solving.

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