

The Area Of A Trapezium Is 1440 Cm. If The Lengths Of Its Parallel Sides Are 54.6 Cm And 35.4 Cm, Find

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Understanding the properties and calculations related to trapeziums is essential in geometry, especially when determining their area based on given dimensions. In this guide, we will explore the problem statement, derive the necessary formulas, and step-by-step solve for the unknown height of the trapezium, providing clarity and insights into the process.

Introduction to Trapezium and Its Properties

Before delving into the calculations, it's important to understand what a trapezium (or trapezoid in some regions) is and its defining characteristics.

What Is a Trapezium?

- A trapezium is a quadrilateral with exactly one pair of parallel sides.
- The parallel sides are called the bases, and the non-parallel sides are called the legs.
- The shape can be irregular, but the key feature remains the parallel sides.

Key Properties of a Trapezium

- The lengths of the two parallel sides are crucial for calculating the area.
- The height (or altitude) of the trapezium is the perpendicular distance between the two bases.
- The area formula depends on the lengths of the bases and the height.

Understanding the Given Data

The problem provides specific measurements:

- Area of the trapezium = 1440 cm^2
- Length of one parallel side (base 1) = 54.6 cm
- Length of the other parallel side (base 2) = 35.4 cm

Our goal is to find the height (h) of the trapezium.

Formulating the Area Equation

The standard formula to calculate the area of a trapezium is:

Area Formula:

$$\text{Area} = \frac{1}{2} \times (\text{sum of parallel sides}) \times \text{height}$$

Expressed mathematically:

$$A = \frac{1}{2} (a + b) h$$

Where:

- A is the area,
- a and b are the lengths of the parallel sides,
- h is the height.

Given:

$$A = 1440 \text{ cm}^2$$

$$a = 54.6 \text{ cm}$$

$$b = 35.4 \text{ cm}$$

Plugging these into the formula:

$$1440 = \frac{1}{2} (54.6 + 35.4) h$$

Next, we simplify the sum of the bases.

Calculating the Sum of the Bases

Add the lengths of the parallel sides:

$$54.6 + 35.4 = 90 \text{ cm}$$

So the area equation becomes:

$$1440 = \frac{1}{2} \times 90 \times h$$

Simplify further:

$$1440 = 45 \times h$$

To find the height h :

$$h = \frac{1440}{45}$$

Calculate:

$$h = 32 \text{ cm}$$

Thus, the height of the trapezium is 32 centimeters.

Summary of the Solution

Step	Description	Calculation	Result
1	Write the area formula	$A = \frac{1}{2}(a + b)h$	-
2	Plug in known values	$1440 = \frac{1}{2}(54.6 + 35.4)h$	-
3	Sum of bases	$54.6 + 35.4 = 90$	90 cm
4	Simplify the formula	$1440 = 45h$	-
5	Solve for h	$h = \frac{1440}{45}$	32 cm

The height of the trapezium is therefore 32 centimeters.

Additional Insights and Related Concepts

While this problem focuses on finding the height, several other related concepts are useful when dealing with trapeziums:

1. Area Calculation with Different Base Lengths

- The area formula remains the same regardless of the specific lengths, as long as the height is known.

2. Finding the Length of Non-Parallel Sides

- If the non-parallel sides are known or need to be calculated, the Pythagorean theorem can be applied, especially if the height and the bases are known.

3. Using the Properties for Optimization

- Problems involving maximizing or minimizing the area often involve adjusting side lengths or heights within constraints.

Practical Applications of Trapezium Area Calculations

Understanding how to compute the area of a trapezium has numerous real-world applications, including:

- Architecture and Construction:** Designing structures with trapezoidal components, such as staircases or roof trusses.

2. **Landscaping:** Calculating the area of irregular plots of land that approximate trapezoidal shapes.
3. **Manufacturing:** Cutting materials into trapezoidal shapes, where precise area calculations are essential for material estimation.
4. **Art and Design:** Creating patterns or artworks that incorporate trapezoidal shapes with specific dimensions.

Conclusion

In this comprehensive guide, we've explored the problem involving the area of a trapezium with given parameters. By understanding the fundamental formula and carefully substituting the known values, we've successfully computed the height as 32 centimeters. Mastery of such problems enhances spatial reasoning and mathematical proficiency, essential skills in various scientific and engineering fields.

Whether you're a student preparing for exams or a professional working on practical applications, grasping how to determine the dimensions of trapeziums is invaluable. Remember, the key steps involve recognizing the relevant formula, correctly substituting known values, and performing accurate calculations.

FAQs

Q1: Can I find the lengths of the non-parallel sides if I know the height and the bases?

Yes, using the Pythagorean theorem, you can calculate the lengths of non-parallel sides if their horizontal projections and the height are known.

Q2: What if the area was not given? How would I find the area?

If the height and bases are known, simply plug the values into the area formula: $A = \frac{1}{2}(a + b)h$.

Q3: Are there other methods to find the area of a trapezium?

Yes, if the non-parallel sides and angles are known, methods such as dividing the trapezium into triangles or using coordinate geometry can be employed.

By mastering these concepts and techniques, you'll be well-equipped to solve various geometric problems involving trapeziums and other quadrilaterals.

Frequently Asked Questions

What is the formula to find the area of a trapezium?

The area of a trapezium is given by the formula: $\text{Area} = \frac{1}{2} \times (\text{sum of parallel sides}) \times \text{height}$.

Given the area of a trapezium is 1440 cm² and the lengths of the parallel sides are 54.6 cm and 35.4 cm, how do you find the height?

Use the formula: $1440 = \frac{1}{2} \times (54.6 + 35.4) \times \text{height}$. Simplify and solve for height: $\text{height} = (2 \times 1440) / (54.6 + 35.4)$.

Calculate the height of the trapezium with the given dimensions.

$\text{Height} = (2 \times 1440) / (54.6 + 35.4) = 2880 / 90 = 32 \text{ cm}$.

What is the significance of the sum of the parallel sides in calculating the area?

The sum of the parallel sides is multiplied by the height and then halved to find the area of a trapezium.

Can the formula for the area of a trapezium be derived from the rectangle and triangle areas?

Yes, the area formula can be derived by dividing the trapezium into a rectangle and two triangles and summing their areas.

If the lengths of the parallel sides change, how does it affect the area of the trapezium?

The area is directly proportional to the sum of the parallel sides; increasing or decreasing these sides will proportionally increase or decrease the area.

What are common real-world applications of calculating the area of a trapezium?

Applications include designing ramps, roofing structures, and land measurement where trapezoidal shapes are common.

Additional Resources

Area of a Trapezium: An In-Depth Exploration of Calculation and Practical Applications

When delving into the fascinating world of geometry, the trapezium (or trapezoid, as referred to in some regions) stands out as a versatile and intriguing shape. Its unique structure—characterized by two parallel sides of varying lengths—makes it a fundamental element in numerous real-world applications, from architecture to engineering. In this article, we'll explore a specific problem involving a trapezium with a known area and parallel side lengths, providing a comprehensive guide on how to determine the missing height, and discussing the broader implications of such calculations.

Understanding the Basics: What Is a Trapezium?

Before diving into the problem specifics, it's essential to establish a clear understanding of what a trapezium is. A trapezium is a quadrilateral with exactly one pair of parallel sides. These sides are known as the bases of the trapezium, and their lengths are crucial in calculating the area.

Key features:

- Parallel sides: These are typically labeled as a and b .
- Non-parallel sides: These can vary in length, often denoted as c and d .
- Height (h): The perpendicular distance between the two bases, essential for area calculations.

Given Data and Problem Statement

Let's consider the specific problem at hand:

> The area of a trapezium is 1440 cm^2 . The lengths of its parallel sides are 54.6 cm and 35.4 cm . Find the height of the trapezium.

This problem exemplifies a common scenario where some information is known, but a key dimension—here, the height—is missing. The goal is to find the height, h , given the area and the lengths of the bases.

The Formula for the Area of a Trapezium

The area A of a trapezium with bases a and b and height h is given by the well-known formula:

$$A = \frac{1}{2} (a + b) \times h$$

This formula reflects that the area is essentially the average of the two bases multiplied by the height, akin to the area calculation for a rectangle or triangle, adapted for trapeziums.

Step-by-Step Solution Approach

To determine the height, we'll rearrange the formula:

$$h = \frac{2A}{a + b}$$

Let's break down each step:

Step 1: Identify Known Values

- Area, $(A = 1440, \text{cm}^2)$
- Base 1, $(a = 54.6, \text{cm})$
- Base 2, $(b = 35.4, \text{cm})$

Step 2: Calculate the Sum of the Bases

$$a + b = 54.6 + 35.4 = 90, \text{cm}$$

Step 3: Plug Values into the Rearranged Formula

$$h = \frac{2 \times 1440}{90}$$

Step 4: Perform the Calculation

$$h = \frac{2880}{90} = 32, \text{cm}$$

Result: The height of the trapezium is 32 cm.

Implications and Practical Significance

Knowing the height of a trapezium is not just a theoretical exercise; it has significant practical applications:

- Architectural Design: Calculating the height helps in designing structures with specific aesthetic or functional features.
- Manufacturing and Material Estimation: Determining the height aids in estimating the amount of material needed for fabrication, such as in sheet metal or fabric covers.
- Landscaping and Land Measurement: Trapezoidal plots of land require accurate area and height measurements for proper planning.

Further Considerations and Related Calculations

While the primary goal was to find the height, there are other interesting aspects to explore:

1. Finding the Length of Non-Parallel Sides

If the lengths of the non-parallel sides are known or estimated, one can determine the shape's exact dimensions and angles, which are crucial in construction.

2. Calculating the Perimeter

Knowing all sides allows for perimeter calculation:

$$P = a + b + c + d$$

Where (c) and (d) are the non-parallel sides.

3. Area Variations with Changing Bases

Understanding how the area responds to changes in base lengths or height helps in optimization problems, such as maximizing area within certain constraints.

Common Mistakes to Avoid

When tackling such problems, be cautious of the following pitfalls:

- Using the incorrect formula: Remember that the area formula involves the sum of bases, not the difference.
- Unit inconsistencies: Ensure all measurements are in the same units before calculations.
- Misreading data: Double-check the given dimensions to avoid errors in substitution.

Conclusion: The Power of Geometric Calculations

Through this exploration, we've demonstrated that even with limited data, applying fundamental formulas allows us to uncover critical dimensions of geometric shapes. The calculation of the trapezium's height from area and base lengths exemplifies the practical utility of mathematical principles in real-world contexts.

Understanding how to manipulate and apply these formulas enhances problem-solving skills, aids in various engineering and design tasks, and fosters a deeper appreciation for the beauty and utility of geometry. Whether you're constructing architectural models, designing landscapes, or simply exploring mathematical concepts, mastering such calculations empowers you to approach complex problems with confidence and precision.

In summary:

- The area of a trapezium with bases 54.6 cm and 35.4 cm and an area of 1440 cm² corresponds to a height of 32 cm.
- The key formula used:
$$h = \frac{2A}{a + b}$$
- Practical applications extend across numerous fields, emphasizing the importance of understanding and applying geometric principles effectively.

By mastering these calculations, you not only solve specific problems but also develop a robust toolkit for tackling diverse challenges involving geometric shapes and measurements.

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