

Find The Area Of A Parallelogram ABCD With $AB = 7$ M. $AD = 20$ M And $\angle BAD = 62^\circ$.

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Calculating the area of a parallelogram requires understanding its dimensions and the angles between its sides. Given the measurements of sides AB and AD , along with the included angle $\angle BAD$, we can determine the area accurately. This problem involves applying trigonometry and geometric principles to find the area of parallelogram $ABCD$, a fundamental shape in geometry with numerous applications in mathematics, engineering, and architecture.

Understanding the Given Data

Before delving into calculations, it's essential to interpret the provided measurements correctly. The data given includes:

- $AB = 7$ meters
- $AD = 20$ meters
- $\angle BAD = 62^\circ$

In a parallelogram $ABCD$, sides AB and AD are adjacent sides meeting at vertex A . The angle $\angle BAD$ is the angle between sides AB and AD at vertex A . Recognizing this helps visualize the shape and set up calculations accurately.

Key Concepts and Formulas

1. Properties of a Parallelogram

A parallelogram has the following properties:

- Opposite sides are equal and parallel.
- Adjacent sides are connected at an angle, which is not necessarily 90° .
- The area can be computed using the base and height or side lengths and included angles.

2. Area Calculation Formulas

The area of a parallelogram can be found using:

- Base $\times$ Height
- Side $\times$ Side $\times$ Sin of included angle

Since we are given two sides and an angle, the most straightforward approach is to use the formula:

$$\text{Area} = AB \times AD \times \sin(\angle BAD)$$

Step-by-Step Calculation

1. Identify Known Values

- AB = 7 meters (length of side AB)
- AD = 20 meters (length of side AD)
- $\angle BAD = 62^\circ$ (angle between AB and AD at vertex A)

2. Compute the Sine of the Angle

To calculate the area, we need $\sin(62^\circ)$. Using a calculator or sine table:

$$\sin(62^\circ) \approx 0.8763$$

3. Apply the Area Formula

Using the formula:

$$\text{Area} = AB \times AD \times \sin(62^\circ)$$

Substitute the known values:

$$\text{Area} = 7 \times 20 \times 0.8763$$

Calculate step-by-step:

- $(7 \times 20 = 140)$ meters²
- $(140 \times 0.8763 \approx 122.68)$ meters²

Thus, the area of parallelogram ABCD is approximately 122.68 square meters.

Alternative Methods for Verification

1. Using the Height and Base

If we consider side AB as the base, the height (h) can be found using the side AD and the included angle:

$$h = AD \times \sin(62^\circ)$$

Calculate:

$$h = 20 \times 0.8763 \approx 17.526, \text{ m}$$

Then, the area:

$$\text{Area} = \text{Base} \times \text{Height} = 7 \times 17.526 \approx 122.68, \text{ m}^2$$

which confirms our previous calculation.

2. Using Vector Approach (Advanced)

Representing sides as vectors can also help in computing the area via the cross product.

- Let $\vec{AB} = (7, 0)$ (assuming AB along x-axis)

- Find $\vec{AD}$ using the length and angle:

$$\vec{AD} = (20 \cos 62^\circ, 20 \sin 62^\circ)$$

Calculate:

$$20 \cos 62^\circ \approx 20 \times 0.4695 = 9.39$$

$$20 \sin 62^\circ \approx 17.526$$

Thus, $\vec{AD} \approx (9.39, 17.526)$

The magnitude of the cross product of $\vec{AB}$ and $\vec{AD}$ gives the area:

$$\text{Area} = |\vec{AB} \times \vec{AD}| = 7 \times 17.526 = 122.68, \text{ m}^2$$

Conclusion

Calculating the area of parallelogram ABCD with given side lengths and included angle demonstrates how geometric and trigonometric principles work together. The area is approximately 122.68 square meters, obtained by applying the formula involving side lengths and the sine of the included angle. This approach not only provides an accurate result but also reinforces the importance of understanding angles and side relationships in geometric figures.

Practical Applications

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

- Designing architectural structures
- Calculating material requirements for construction projects
- Analyzing forces in physics and engineering
- Creating geometric models in computer graphics

Mastering these calculations enhances spatial awareness and problem-solving skills vital in various technical fields.

Frequently Asked Questions

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

The area of a parallelogram is given by the formula: $\text{Area} = \text{base} \times \text{height}$.

How can I find the height of the parallelogram ABCD using side lengths and angle BAD?

You can find the height by using the formula: $\text{height} = \text{AD} \times \sin(\text{BAD})$.

Given $\text{AB} = 7 \text{ m}$, $\text{AD} = 20 \text{ m}$, and angle $\text{BAD} = 62^\circ$, what is the height of the parallelogram?

$\text{Height} = 20 \text{ m} \times \sin(62^\circ) \approx 20 \text{ m} \times 0.8829 \approx 17.66 \text{ meters}$.

How do I compute the area of the parallelogram ABCD with the given measurements?

Use the formula: $\text{Area} = \text{base (AB)} \times \text{height}$. With $\text{AB} = 7 \text{ m}$ and $\text{height} \approx 17.66 \text{ m}$, $\text{Area} \approx 7 \text{ m} \times 17.66 \text{ m} \approx 123.62 \text{ square meters}$.

Is it necessary to find the length of side AD to calculate the area?

No, the length of AD is used to find the height when the angle is known. If the height is directly given or known, you can calculate the area without needing the length of AD.

Can the area of the parallelogram be calculated directly from the given angle without calculating height?

Yes, if you consider the side AB as the base and use the component of AD perpendicular to AB, the area can be found as $\text{AB} \times \text{AD} \times \sin(\text{BAD})$.

What is the approximate area of the parallelogram ABCD based on the given data?

Using the formula: $\text{Area} \approx \text{AB} \times \text{AD} \times \sin(62^\circ) = 7 \text{ m} \times 20 \text{ m} \times 0.8829 \approx 123.6 \text{ square meters}$.

Are there any other methods to find the area of the parallelogram with the given information?

Yes, if you have the coordinates of the points or other angles, you could use coordinate geometry or vector cross products to find the area. But with side lengths and included

angle, the sine formula is most straightforward.

Additional Resources

Find The Area Of A Parallelogram ABCD With $AB = 7$ M, $AD = 20$ M, And $BAD = 62^\circ$

Introduction

The problem of determining the area of a parallelogram with given side lengths and an included angle is a classic exercise in coordinate geometry and trigonometry. In this particular case, we are asked to find the area of parallelogram ABCD, where the side lengths are known: $AB = 7$ meters, $AD = 20$ meters, and the angle $BAD = 62^\circ$. This scenario provides an excellent opportunity to explore geometric principles and apply formulas efficiently to arrive at an accurate solution.

Understanding the problem in detail involves dissecting the properties of parallelograms, analyzing the given data, and identifying the most effective approach to compute the area. This article presents a comprehensive investigation into the problem, delving into geometric concepts, solution strategies, and detailed calculations.

Understanding the Geometric Configuration

The Parallelogram ABCD

A parallelogram is a quadrilateral with opposite sides parallel and equal in length. In our case:

- Side AB has length 7 meters.
- Side AD has length 20 meters.
- The angle between sides AB and AD at vertex A, denoted as BAD , is 62° .

This configuration implies that:

- AB and AD are adjacent sides meeting at vertex A.
- The angle BAD is the interior angle between sides AB and AD at vertex A.
- Opposite sides BC and AD are equal and parallel; similarly, AB and DC are equal and parallel.

The goal is to find the area of this parallelogram, which can be achieved by leveraging the given data about sides and angles.

Analytical Approach: Using Trigonometry to Find the Area

The most straightforward method to find the area of the parallelogram in this context

involves the use of the formula:

$$\text{Area} = (\text{Side}_1) \times (\text{Side}_2) \times \sin(\text{Included Angle})$$

Where:

- Side_1 and Side_2 are adjacent sides of the parallelogram.
- The included angle is the angle between these sides.

Given that:

- Side AB = 7 m
- Side AD = 20 m
- The angle BAD = 62°

The problem reduces to calculating:

$$\text{Area} = AB \times AD \times \sin(62^\circ)$$

Step-by-Step Calculation

1. Confirming the Geometry

Since the sides AB and AD are adjacent and meet at vertex A with an angle of 62° , the angle between these sides is directly given, making the calculation straightforward.

2. Computing $\sin(62^\circ)$

Using standard trigonometric values or a calculator:

$$\sin(62^\circ) \approx 0.8829$$

3. Applying the Area Formula

$$\begin{aligned} \text{Area} &= 7 \text{ m} \times 20 \text{ m} \times 0.8829 \\ \text{Area} &= 140 \times 0.8829 \approx 123.606 \text{ m}^2 \end{aligned}$$

Thus, the approximate area of the parallelogram is:

$$\boxed{\text{Area} \approx 123.61 \text{ m}^2}$$

Validating the Approach: Geometric Justification

The methodology hinges on the fact that the area of a parallelogram can be computed with two adjacent sides and the included angle. The key assumptions are:

- The given angle BAD is the interior angle between sides AB and AD.
- The sides AB and AD are adjacent, which aligns with the standard definition of the parallelogram's sides.

Given these conditions, the calculation is valid and directly applicable.

Additional Considerations and Alternative Methods

1. Coordinate Geometry Approach

To reinforce the solution, one could assign coordinate points to vertices A, B, and D:

- Place point A at the origin: $(A(0, 0))$
- Place B along the x-axis: $(B(7, 0))$
- Place D based on the length and angle:

$$D = (20 \cos 62^\circ, 20 \sin 62^\circ)$$

Calculating:

$$D_x = 20 \cos 62^\circ \approx 20 \times 0.4695 \approx 9.39 \text{ m}$$

$$D_y = 20 \sin 62^\circ \approx 20 \times 0.8829 \approx 17.66 \text{ m}$$

The coordinate positions are:

- $(A(0, 0))$
- $(B(7, 0))$
- $(D(9.39, 17.66))$

The vector $(\vec{AB} = (7, 0))$

The vector $(\vec{AD} = (9.39, 17.66))$

The area of the parallelogram is equal to the magnitude of the cross product of these vectors:

$$\text{Area} = |\vec{AB} \times \vec{AD}| = |(7,0) \times (9.39,17.66)|$$

In 2D, the cross product magnitude is:

$$|7 \times 17.66 - 0 \times 9.39| = 7 \times 17.66 \approx 123.62 \text{ m}^2$$

This matches our previous calculation, confirming the consistency and validity of the approach.

Summary of Findings

Parameter	Value	Explanation
Side AB	7 meters	Given side length
Side AD	20 meters	Given side length
Included angle BAD	62°	Given angle between sides AB and AD
$\sin(62^\circ)$	0.8829	Trigonometric value
Calculated Area	approximately 123.61 m ²	Final result

Broader Implications and Practical Applications

Understanding how to compute the area of a parallelogram with given sides and angles is fundamental in fields such as civil engineering, architecture, and land surveying. Such calculations assist in estimating material requirements, land measurements, and structural designs.

The method outlined here demonstrates the power of combining basic geometric principles with trigonometry to solve real-world problems efficiently. It also highlights the importance of coordinate geometry as a verification tool, providing a visual and algebraic perspective that complements the trigonometric approach.

Conclusion

The problem of finding the area of a parallelogram ABCD, with sides AB = 7 meters, AD = 20 meters, and an interior angle BAD of 62°, is elegantly solvable through the application of the area formula involving the sine of the included angle. Both the direct trigonometric method and the coordinate geometry approach yield consistent results, confirming the accuracy of the calculation.

The area of the parallelogram is approximately 123.61 square meters. This example underscores the importance of understanding geometric relationships and trigonometric functions in practical problem-solving contexts.

References

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