

A Rectangular Prism Has A Length Of 10 Inches, A Width Of 2 Inches, And A Height Of 5 Inches. What Is

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Understanding the properties and calculations related to rectangular prisms is fundamental in geometry, especially when dealing with real-world objects and spatial reasoning. In this article, we will explore the dimensions of a rectangular prism with a length of 10 inches, a width of 2 inches, and a height of 5 inches. We will delve into how to calculate its volume, surface area, and other relevant measurements, providing a comprehensive guide to understanding this three-dimensional shape.

What Is a Rectangular Prism?

A rectangular prism, also known as a rectangular cuboid, is a three-dimensional geometric figure with six rectangular faces. It has length, width, and height as its three dimensions, and all angles between faces are right angles (90 degrees). Rectangular prisms are common in everyday objects like boxes, bricks, and buildings.

Dimensions of the Prism

Given dimensions:

- Length (l) = 10 inches
- Width (w) = 2 inches
- Height (h) = 5 inches

These measurements define the size of the prism along its three axes.

Calculating the Volume of a Rectangular Prism

The volume of a rectangular prism measures how much space it occupies. It is calculated by multiplying its length, width, and height:

Volume Formula

$$V = l \times w \times h$$

Applying the Dimensions

Using the given dimensions:

$$\text{Volume} = 10 \text{ in} \times 2 \text{ in} \times 5 \text{ in} = 100 \text{ cubic inches}$$

Therefore, the prism's volume is 100 cubic inches.

Calculating the Surface Area

The surface area represents the total area covered by the outer surfaces of the prism. It is useful for determining material requirements, such as paint or wrapping paper.

Surface Area Formula

For a rectangular prism:

$$\text{Surface Area} = 2(lw + lh + wh)$$

Calculating Each Term

- $lw = 10 \times 2 = 20 \text{ in}^2$
- $lh = 10 \times 5 = 50 \text{ in}^2$
- $wh = 2 \times 5 = 10 \text{ in}^2$

Applying the Formula

$$\text{Surface Area} = 2(20 + 50 + 10) = 2(80) = 160 \text{ in}^2$$

Thus, the total surface area of the prism is 160 square inches.

Additional Geometric Properties

Understanding other properties enhances our comprehension of the shape's spatial characteristics.

Diagonal Length

The space diagonal of a rectangular prism connects two opposite vertices, passing through the interior of the shape.

Diagonal Formula

$$d = \sqrt{l^2 + w^2 + h^2}$$

Calculation

$$d = \sqrt{10^2 + 2^2 + 5^2} = \sqrt{100 + 4 + 25} = \sqrt{129} \approx 11.36 \text{ inches}$$

The diagonal length is approximately 11.36 inches.

Applications of Rectangular Prism Calculations

Knowing how to calculate volume and surface area of a rectangular prism has practical applications across various fields:

- **Packaging:** Determining the size of boxes needed to contain objects.
- **Construction:** Calculating material quantities for building blocks or bricks.
- **Manufacturing:** Designing products with specific spatial requirements.
- **Education:** Teaching geometric concepts and problem-solving skills.

Real-World Examples

Let's explore some practical examples that involve a rectangular prism with the given dimensions.

Example 1: Packaging a Product

Suppose you are designing a box for shipping a product measuring 10 inches in length, 2 inches in width, and 5 inches in height. Calculating its volume helps determine how much space the product occupies, which in this case is 100 cubic inches. The surface area of 160 square inches informs you how much material (like cardboard) is needed to make the box.

Example 2: Material Estimation for Construction

A builder needs to know how much concrete is required to make a rectangular block with the given dimensions. The volume of 100 cubic inches allows for precise material calculation.

Summary and Key Takeaways

- A rectangular prism with dimensions 10 inches (length), 2 inches (width), and 5 inches (height) has:
 - Volume: 100 cubic inches
 - Surface Area: 160 square inches
 - Diagonal Length: approximately 11.36 inches
- Understanding these measurements aids in practical applications like packaging, construction, and manufacturing.
- The formulas used are straightforward:
 - Volume: $(l \times w \times h)$
 - Surface Area: $(2(lw + lh + wh))$
 - Space Diagonal: $(\sqrt{l^2 + w^2 + h^2})$

Conclusion

Mastering the calculations related to rectangular prisms enhances both academic understanding and real-world problem-solving skills. Whether you're designing packaging, constructing a building, or exploring geometric concepts, knowing how to determine the volume, surface area, and diagonal length of a rectangular prism is fundamental. With the given dimensions, we've demonstrated how to compute these properties accurately, providing a solid foundation for further exploration in geometry and its applications.

If you want to learn more about geometric shapes or need help with other calculations, numerous resources and tools are available online to assist in expanding your understanding of three-dimensional geometry.

Frequently Asked Questions

What is the volume of a rectangular prism with a length of 10 inches, a width of 2 inches, and a height of 5 inches?

The volume is $10 \text{ inches} \times 2 \text{ inches} \times 5 \text{ inches} = 100 \text{ cubic inches}$.

How do you calculate the surface area of this rectangular prism?

Surface area = $2(\text{length} \times \text{width} + \text{length} \times \text{height} + \text{width} \times \text{height}) = 2(10 \times 2 + 10 \times 5 + 2 \times 5) = 2(20 + 50 + 10) = 2(80) = 160 \text{ square inches}$.

What is the lateral surface area of the prism?

Lateral surface area = $2(\text{height} \times \text{length} + \text{height} \times \text{width}) = 2(5 \times 10 + 5 \times 2) = 2(50 + 10) = 2(60) = 120 \text{ square inches}$.

If the prism is painted on all sides, how much area needs to be painted?

The total surface area is 160 square inches, so that is the area that needs to be painted.

What is the length of the diagonal of the rectangular prism?

Diagonal length = $\sqrt{(\text{length}^2 + \text{width}^2 + \text{height}^2)} = \sqrt{(10^2 + 2^2 + 5^2)} = \sqrt{(100 + 4 + 25)} = \sqrt{129} \approx 11.36$ inches.

If the prism's volume is 100 cubic inches, what is its density if it weighs 20 pounds?

Density = mass $\div$ volume = 20 pounds $\div$ 100 cubic inches = 0.2 pounds per cubic inch.

Additional Resources

Rectangular Prism: An In-Depth Exploration of Its Dimensions, Properties, and Practical Applications

When it comes to understanding geometric shapes, the rectangular prism stands out as a fundamental and versatile figure across various fields—be it architecture, manufacturing, packaging, or education. Today, we delve into a specific example: a rectangular prism with a length of 10 inches, a width of 2 inches, and a height of 5 inches. This detailed analysis aims to provide clarity on its dimensions, surface area, volume, and real-world applications, all presented in an engaging, expert tone.

Understanding the Basics of a Rectangular Prism

Before examining the specific dimensions, it's crucial to understand what defines a rectangular prism.

Definition and Characteristics

A rectangular prism (also called a rectangular box or cuboid) is a three-dimensional shape characterized by six faces, all of which are rectangles. It's a polyhedron with:

- Opposite faces that are congruent rectangles
- Edges that are straight and meet at right angles
- Twelve edges in total
- Eight vertices (corners)

The defining feature is that its length, width, and height are all perpendicular to each other, creating a box-like structure.

Key Dimensions and Terminology

- Length (L): The measurement of the prism along its longest front-to-back dimension.
- Width (W): The measurement across the shorter side, typically the side-to-side dimension.
- Height (H): The measurement from the base to the top, often considered the vertical dimension.

In our specific example, these dimensions are:

- Length = 10 inches
- Width = 2 inches
- Height = 5 inches

Detailed Examination of the Dimensions

Why These Dimensions Matter

Understanding the dimensions is essential because they influence the volume, surface area, and practical usability of the rectangular prism.

Interpreting the Dimensions

- Length (10 inches): This suggests a relatively elongated dimension, which could be suitable for objects like elongated packaging, storage boxes, or components fitting into linear spaces.
- Width (2 inches): A narrow span, indicating a slender profile in that direction, which might be important in stacking or fitting into tight spaces.
- Height (5 inches): A moderate vertical dimension, adding to the overall volumetric capacity.

This combination of measurements hints at a shape that is long and narrow with a moderate height—ideal for certain types of containers, storage units, or structural components.

Calculating Surface Area and Volume

To fully appreciate this rectangular prism, two primary geometric properties are analyzed: surface area and volume. These calculations reveal how much material is needed to construct the object and the space it encloses.

Surface Area Calculation

Surface area (SA) is the total area covered by all six faces of the prism. The formula for the surface area of a rectangular prism is:

$$SA = 2 (LW + LH + WH)$$

Plugging in the dimensions:

- $L = 10$, in
- $W = 2$, in
- $H = 5$, in

Calculations:

$$\begin{aligned} SA &= 2 (10 \times 2 + 10 \times 5 + 2 \times 5) \\ &= 2 (20 + 50 + 10) \\ &= 2 (80) \\ &= 160, \text{ square inches} \end{aligned}$$

Interpretation: To cover or package this prism completely, you'd need 160 square inches of material (like wrapping or surface coating). This is useful in manufacturing and packaging contexts to estimate material costs.

Volume Calculation

Volume (V) measures the space enclosed within the prism. The formula:

$$V = L \times W \times H$$

Calculations:

$$V = 10 \times 2 \times 5 = 100, \text{ cubic inches}$$

Interpretation: The object holds 100 cubic inches of space, which can be converted into other units if needed (for example, approximately 1.64 liters). This makes it suitable for applications where internal capacity is significant.

Practical Applications of the Dimensions

Understanding the shape's dimensions enables insights into its potential uses across different sectors.

Packaging and Storage

The size (10" x 2" x 5") indicates a shape suitable for:

- Narrow, elongated items: Think of small tools, electronic components, or delicate instruments that require a slender container.
- Stackable storage: Its flat, rectangular faces make stacking efficient, especially if multiple units are used.
- Custom packaging: The dimensions can be tailored for items that need to be protected with minimal material.

Structural and Design Uses

In architecture or product design, such a prism can serve as:

- A structural component: For instance, a beam or support element in certain designs.
- A decorative element: Its proportions could be aesthetic in modern minimalist architecture.
- A prototype or model: For scaled-down representations of larger structures.

Educational Purposes

The dimensions serve as an excellent teaching aid for:

- Visualizing 3D geometry
- Practicing volume and surface area calculations
- Understanding spatial relationships

Customization and Variations

While this example uses fixed measurements, the principles extend to other sizes and proportions.

Adjusting Dimensions

- Increasing length while keeping other dimensions constant will increase volume significantly.
- Changing width affects surface area more directly, especially if the width becomes very small or large.
- Modifying height alters the internal volume and surface area, impacting material needs and capacity.

Proportional Scaling

Scaling all dimensions proportionally results in similar shapes but larger or

smaller sizes, affecting:

- Volume (which scales with the cube of the scale factor)
- Surface area (which scales with the square)

This is useful in manufacturing when designing products at different sizes while maintaining proportions.

Final Thoughts: Why Understanding Dimensions Matters

The example of a rectangular prism with specified dimensions illustrates the importance of precise measurements in both theoretical and practical contexts. Whether designing packaging, constructing structures, or educational modeling, a clear grasp of how length, width, and height interplay to define volume and surface area is invaluable.

Key Takeaways:

- The dimensions directly influence the shape's capacity and material requirements.
- Calculations like surface area and volume are essential for cost estimation and functional design.
- Variations in dimensions offer versatility across applications, from packaging to architecture.
- Understanding these principles fosters better decision-making in engineering, manufacturing, and education.

In essence, the simple data—length of 10 inches, width of 2 inches, and height of 5 inches—serves as a foundational example of how geometric understanding translates into real-world utility. Whether you're a student, engineer, or designer, mastering these concepts unlocks a broad spectrum of possibilities for creating and analyzing rectangular prisms and related structures.

In conclusion, the rectangular prism with the given dimensions exemplifies the intersection of basic geometry and practical application. Its surface area of 160 square inches and volume of 100 cubic inches make it a versatile shape that can be adapted for numerous uses—understanding its properties is key to leveraging its full potential in various fields.

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