

What Is The Surface Area Of This Right Rectangular Prism? Enter Your Answer As A Mixed Number In The

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Understanding the surface area of a right rectangular prism is fundamental in geometry, especially when dealing with real-world applications such as packaging, construction, and manufacturing. In this article, we will explore what a right rectangular prism is, how to calculate its surface area, and how to express your answer as a mixed number. Whether you are a student preparing for an exam or someone interested in practical math, this comprehensive guide will walk you through the process step-by-step.

Defining a Right Rectangular Prism

What Is a Rectangular Prism?

A rectangular prism, also known as a rectangular box or cuboid, is a three-dimensional solid figure with six rectangular faces. It has length, width, and height, and all angles between faces are right angles (90 degrees).

Characteristics of a Right Rectangular Prism

- Opposite faces are equal in area.
- All edges meet at right angles.
- It is a type of parallelepiped with rectangular faces.
- Its dimensions are usually labeled as:
 - Length (l)
 - Width (w)
 - Height (h)

Understanding Surface Area

What Is Surface Area?

Surface area refers to the total area covered by the surface of a three-dimensional object. For a right rectangular prism, it includes the combined area of all six faces.

Why Is Surface Area Important?

- In packaging, to determine how much wrapping material is needed.
- In manufacturing, to calculate the amount of paint or finishing required.
- In engineering, to assess material costs and design specifications.

How to Calculate the Surface Area of a Right Rectangular Prism

Formula for Surface Area

The surface area (SA) of a rectangular prism is calculated using the formula:

$$SA = 2(lw + lh + wh)$$

Where:

- l = length
- w = width
- h = height

Step-by-Step Calculation Process

1. Identify Dimensions: Determine the length, width, and height of the prism.
2. Calculate Each Pairwise Area:
 - lw : area of the base rectangle.
 - lh : area of the front/back rectangles.
 - wh : area of the side rectangles.
3. Sum the Areas of Opposite Faces:
 - Since each pair appears twice, multiply the sum by 2.
4. Compute the Total Surface Area.

Expressing the Surface Area as a Mixed Number

Why Use a Mixed Number?

In some cases, the surface area calculation results in a fraction that is not a whole number, and expressing it as a mixed number makes it easier to interpret.

Converting Fractions to Mixed Numbers

- Divide the numerator by the denominator.
- The quotient is the whole number part.
- The remainder over the original denominator forms the fractional part.

Sample Problem: Calculating the Surface Area

Suppose you are given a right rectangular prism with the following dimensions:

- Length (l) = $7 \frac{1}{2}$ units
- Width (w) = $3 \frac{1}{4}$ units
- Height (h) = $4 \frac{2}{3}$ units

Let's walk through the process to find the surface area and express the answer as a mixed number.

Step 1: Convert Mixed Numbers to Improper Fractions

- $l = 7 \frac{1}{2} = \frac{15}{2}$
- $w = 3 \frac{1}{4} = \frac{13}{4}$
- $h = 4 \frac{2}{3} = \frac{14}{3}$

Step 2: Calculate Each Pairwise Product

- $lw = \frac{15}{2} \times \frac{13}{4} = \frac{15 \times 13}{2 \times 4} = \frac{195}{8}$
- $lh = \frac{15}{2} \times \frac{14}{3} = \frac{15 \times 14}{2 \times 3} = \frac{210}{6} = \frac{35}{1}$
- $wh = \frac{13}{4} \times \frac{14}{3} = \frac{13 \times 14}{4 \times 3} = \frac{182}{12} = \frac{91}{6}$

Step 3: Sum the Areas

Express all fractions with a common denominator, for simplicity, let's use 24:

- $lw = \frac{195}{8} = \frac{195 \times 3}{8 \times 3} = \frac{585}{24}$
- $lh = \frac{35}{1} = \frac{35 \times 24}{1 \times 24} = \frac{840}{24}$
- $wh = \frac{91}{6} = \frac{91 \times 4}{6 \times 4} = \frac{364}{24}$

Sum:

$$\left[\frac{585 + 840 + 364}{24} = \frac{1789}{24} \right]$$

Step 4: Multiply by 2 for Total Surface Area

$$\left[SA = 2 \times \frac{1789}{24} = \frac{3578}{24} \right]$$

Simplify the fraction:

$$\left[\frac{3578}{24} = \frac{1789}{12} \right]$$

Step 5: Convert to a Mixed Number

Divide numerator by denominator:

$$- \ (1789 \div 12 = 149 \text{ R } 1)$$

So,

$$\left[\frac{1789}{12} = 149 \frac{1}{12} \right]$$

Final Answer: The surface area of the prism is $149 \frac{1}{12}$ square units.

Summary of Key Steps in Finding Surface Area and Expressing as a Mixed Number

- Convert mixed number dimensions to improper fractions.
- Calculate the areas of each pair of faces.
- Sum these areas and multiply by 2.
- Simplify the resulting fraction.
- Convert the improper fraction to a mixed number.

Additional Tips and Common Mistakes

- Always double-check your conversions from mixed numbers to improper fractions.
- Use a common denominator to add fractions accurately.
- Simplify fractions whenever possible before converting to a mixed number.
- Be cautious with multiplication of fractions, ensuring numerator and denominator are correctly handled.

Conclusion

Calculating the surface area of a right rectangular prism involves understanding the shape's geometry, applying the correct formula, and accurately performing fraction operations. Expressing your result as a mixed number enhances clarity, especially when dealing with fractional dimensions or results. Mastering this process not only boosts your math skills but also prepares you for practical applications in various fields such as engineering, architecture, and packaging design.

By practicing with different dimensions and ensuring careful calculation, you'll become proficient in determining the surface area of rectangular prisms and expressing your answers as mixed numbers with confidence.

Frequently Asked Questions

What is the formula to calculate the surface area of a right rectangular prism?

The surface area is calculated by adding the areas of all six faces: $2(lw + lh + wh)$.

How do I find the surface area of a right rectangular prism with length 8, width 3, and height 4?

Use the formula: $2(8 \times 3 + 8 \times 4 + 3 \times 4) = 2(24 + 32 + 12) = 2(68) = 136$ square units.

If the surface area of a right rectangular prism is $55 \frac{1}{2}$ square units, what could be its dimensions?

Possible dimensions depend on the specific measurements, but you can set up equations based on $2(lw + lh + wh) = 55 \frac{1}{2}$ and solve for the dimensions accordingly.

Why is it important to express the surface area as a mixed number in certain problems?

Expressing as a mixed number provides a clearer, more precise measurement when the surface area isn't a whole number, making it easier to interpret and use in real-world contexts.

Can the surface area of a right rectangular prism be a fractional number? How?

Yes, if the measurements involve fractions or decimals, the calculated surface area can result in a fractional or mixed number when expressed in simplest form.

Additional Resources

What Is The Surface Area Of This Right Rectangular Prism? Enter Your Answer As A Mixed Number In The

Understanding the surface area of a three-dimensional object is fundamental in various fields, from manufacturing and construction to everyday problem-solving in education. Among the simplest yet most informative shapes to analyze is the right rectangular prism, a geometric figure characterized by six rectangular faces, with opposite faces being congruent. When tasked with calculating the surface area of such a prism, especially in educational contexts, it's common to encounter problems requiring the answer to be expressed as a mixed number. This article aims to provide an in-depth exploration of what the surface area of a right rectangular prism entails, how to calculate it systematically, and the significance of expressing the answer as a mixed number.

Understanding the Right Rectangular Prism

Definition and Characteristics

A right rectangular prism is a three-dimensional solid object where:

- All faces are rectangles.
- The bases are congruent rectangles aligned directly above each other.
- The sides are perpendicular to the bases, making the prism "right" (as opposed to oblique).

Commonly referred to as a "box" or "cuboid," this shape is one of the most straightforward 3D figures due to its regularity and the ease of calculating its surface area and volume.

Dimensions and Notation

To analyze a right rectangular prism, three main dimensions are essential:

- Length (l): the measurement of the base along the x-axis.
- Width (w): the measurement perpendicular to length along the y-axis.

- Height (h): the measurement perpendicular to the base plane along the z-axis.

These dimensions are typically provided or can be measured directly. For example, suppose:

- Length = 5 units
- Width = 3 units
- Height = 4 units

Understanding these dimensions is crucial because the surface area depends directly on them.

Surface Area: Definition and Significance

What Is Surface Area?

Surface area refers to the total area covered by the surface of a three-dimensional object. For a right rectangular prism, it involves summing the areas of all six rectangular faces.

Mathematically:

Surface Area (SA) = Sum of areas of all six faces

This measure is vital for various practical applications such as:

- Determining the amount of material needed to cover an object.
- Calculating paint or coating requirements.
- Estimating heat transfer or insulation needs.

Why Express the Answer as a Mixed Number?

In many educational settings, students are encouraged to express their answers as mixed numbers rather than improper fractions or decimals for clarity and convention.

For instance, if the surface area calculation results in a fraction like $\frac{37}{4}$, it is often expressed as a mixed number: $9 \frac{1}{4}$. This format enhances readability and understanding, especially when dealing with measurements that are not whole numbers.

Calculating Surface Area: Step-by-Step Approach

Step 1: Identify and List Dimensions

The first step involves noting the given dimensions:

- Length (l)
- Width (w)
- Height (h)

Suppose, for example:

- $l = 7/2$ units (which is 3.5 units)
- $w = 4$ units
- $h = 3/2$ units (which is 1.5 units)

Expressing fractional dimensions as mixed numbers or improper fractions helps in precise calculations.

Step 2: Calculate the Area of Each Pair of Opposite Faces

The surface area of a right rectangular prism can be calculated by summing the areas of opposite faces, which come in three pairs:

1. Two faces with dimensions $l \times w$
2. Two faces with dimensions $l \times h$
3. Two faces with dimensions $w \times h$

Calculations:

- Area of the first pair: $2 \times (l \times w)$
- Area of the second pair: $2 \times (l \times h)$
- Area of the third pair: $2 \times (w \times h)$

Using the example dimensions:

- $l = 7/2$, $w = 4$, $h = 3/2$

Calculate each:

- $l \times w = (7/2) \times 4 = (7/2) \times (4/1) = (7 \times 4) / 2 = 28 / 2 = 14$
- $l \times h = (7/2) \times (3/2) = (7 \times 3) / (2 \times 2) = 21 / 4$
- $w \times h = 4 \times (3/2) = (4 \times 3) / 2 = 12 / 2 = 6$

Now, double each:

- $2 \times (l \times w) = 2 \times 14 = 28$
- $2 \times (l \times h) = 2 \times 21/4 = (2 \times 21)/4 = 42/4 = 21/2$
- $2 \times (w \times h) = 2 \times 6 = 12$

Step 3: Sum All Areas to Find Total Surface Area

Add all these results:

- Total SA = $28 + 21/2 + 12$

To combine these, convert all to improper fractions with a common denominator:

- $28 = 56/2$

- $12 = 24/2$

Sum:

$$SA = 56/2 + 21/2 + 24/2 = (56 + 21 + 24) / 2 = 101 / 2$$

Expressed as a mixed number:

- $101 / 2 = 50 \frac{1}{2}$

Final Answer:

The surface area of this right rectangular prism is $50 \frac{1}{2}$ square units.

Additional Considerations and Practical Implications

Handling Different Dimensions and Units

While the example used fractional dimensions, in real-world scenarios, dimensions may be in various units (meters, inches, centimeters). It's critical to maintain consistency in units throughout calculations to ensure accuracy.

Dealing with Complex Prisms

For irregular or composite shapes, calculating surface area may involve subdividing the shapes into simpler components, applying the same principles, and summing their surface areas.

Applications Across Industries

- Manufacturing: Estimating the amount of coating or paint required.
- Construction: Calculating materials for covering surfaces like walls or boxes.
- Packaging: Designing boxes with optimal material use.
- Science: Studying heat transfer or insulation needs based on surface exposure.

Conclusion: The Importance of Accurate Surface Area Calculation

Accurate computation of the surface area of a right rectangular prism is more than a mathematical exercise; it's a practical skill that underpins numerous real-world applications. The process involves understanding the shape's dimensions, methodically calculating the areas of individual faces, and summing these to find the total. Expressing the answer as a mixed number enhances clarity, especially in educational contexts. Whether designing packaging, estimating materials, or exploring geometric properties, mastering surface area calculations empowers professionals and students alike to make informed decisions and solve problems efficiently.

In essence, the surface area of a right rectangular prism encapsulates both the simplicity and the utility of geometric principles, serving as a foundational concept that bridges theory and practice.

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