

What Is The Volume Of A Hemisphere With A Radius Of 29.6in, Rounded To The Nearest Tenth Of A Cubic Inch?

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Understanding the volume of a hemisphere is a fundamental concept in geometry, frequently encountered in various fields such as engineering, architecture, and design. Whether you're calculating the capacity of a dome-shaped structure or working on a scientific project involving spherical objects, knowing how to determine the volume of a hemisphere is invaluable. In this article, we will explore the detailed process of calculating the volume of a hemisphere with a specific radius of 29.6 inches, and how to round the result to the nearest tenth of a cubic inch. We will also discuss related concepts, formulas, and practical applications to provide a comprehensive understanding.

What Is a Hemisphere?

A hemisphere is a three-dimensional geometric shape that represents half of a sphere. Imagine slicing a sphere precisely in half through its center; the cut surface is a perfect circle, and the remaining shape is the hemisphere.

Characteristics of a Hemisphere

- It has a flat circular base and a curved surface.
- The flat base has a radius equal to that of the original sphere.
- The curved surface is a "half-sphere," covering the circular base.

Common Uses of Hemispheres

- Architectural designs such as domes.
- Scientific models representing planetary bodies.
- Manufacturing of hemispherical containers or lenses.

Understanding the properties of a hemisphere is essential for accurate volume calculations, which we'll delve into next.

Mathematical Formula for the Volume of a Hemisphere

The volume of a hemisphere is derived from the volume formula of a sphere, which is:

$$V_{\text{sphere}} = \frac{4}{3} \pi r^3$$

Since a hemisphere is exactly half of a sphere, its volume formula is:

$$V_{\text{hemisphere}} = \frac{1}{2} \times \frac{4}{3} \pi r^3 = \frac{2}{3} \pi r^3$$

where:

- $V_{\text{hemisphere}}$ is the volume of the hemisphere,
- r is the radius of the hemisphere,
- π is approximately 3.14159.

The Volume Formula in Detail

$$V_{\text{hemisphere}} = \frac{2}{3} \pi r^3$$

This formula allows us to calculate the volume directly once the radius is known.

Calculating the Volume of a Hemisphere with a Radius of 29.6 Inches

Given:

- Radius $r = 29.6$ inches

Step 1: Plug the radius into the volume formula

$$V_{\text{hemisphere}} = \frac{2}{3} \pi (29.6)^3$$

Step 2: Calculate r^3

$$29.6^3 = 29.6 \times 29.6 \times 29.6$$

Let's compute this step-by-step:

- $29.6 \times 29.6 = 876.16$
- 876.16×29.6

Calculating:

$$\begin{aligned} & 876.16 \times 29.6 \\ &= (876.16 \times 30) - (876.16 \times 0.4) \\ &= (876.16 \times 30) - (876.16 \times 0.4) \\ &= 26,284.8 - 350.464 \\ &= 25,934.336 \end{aligned}$$

Thus,

$$r^3 = 25,934.336$$

Step 3: Multiply by π

$$\pi \times r^3 = 3.14159 \times 25,934.336$$

Calculating:

$$3.14159 \times 25,934.336 \approx 81,486.213$$

Step 4: Multiply by $\left(\frac{2}{3}\right)$

$$V_{\text{hemisphere}} = \frac{2}{3} \times 81,486.213$$

Calculating:

$$\left(\frac{2}{3}\right) \times 81,486.213 = 2 \times \frac{81,486.213}{3}$$

$$= 2 \times 27,162.071$$

$$= 54,324.142$$

Final Result:

The volume of the hemisphere with a radius of 29.6 inches is approximately 54,324.1 cubic inches when rounded to the nearest tenth.

Rounding to the Nearest Tenth of a Cubic Inch

In our calculation, the volume is approximately 54,324.142 cubic inches. To round to the nearest tenth:

- Look at the hundredth's place (which is 4).
- Since 4 is less than 5, we do not round up the tenth's place.

Therefore, the volume rounded to the nearest tenth is:

54,324.1 cubic inches

Additional Considerations in Volume Calculations

While the above calculation provides a precise estimate, there are additional considerations to keep in mind when dealing with real-world applications:

1. Measurement Accuracy

- Ensure the radius measurement is precise, as small errors can significantly affect the volume calculation.
- Use accurate measuring tools, such as a tape measure or calipers, for real-world scenarios.

2. Units Consistency

- Always keep units consistent throughout calculations.
- If working in different units, convert all measurements to inches before calculations.

3. Material and Structural Considerations

- When applying this volume to physical objects, consider material thickness and manufacturing tolerances.

4. Practical Applications

- Designing hemispherical tanks, domes, or other structures.
- Calculating capacities for storage or fluid dynamics.

Related Formulas and Concepts

Understanding the volume of a hemisphere opens up pathways to explore related geometric concepts:

Volume of a Full Sphere

$$V_{\text{sphere}} = \frac{4}{3} \pi r^3$$

Surface Area of a Hemisphere

$$A_{\text{hemisphere}} = 2 \pi r^2 + \pi r^2 = 3 \pi r^2$$

(Includes both the curved surface and the flat circular base.)

Segment of a Sphere

The part of a sphere cut off by a plane, useful in advanced applications.

Practical Applications of Hemisphere Volume Calculation

Knowing how to calculate the volume of a hemisphere has numerous practical uses:

- Architectural Design: Calculating the capacity of dome-shaped roofs or structures.
- Manufacturing: Designing hemispherical containers for liquids or solids.
- Science and Research: Measuring the volume of planetary models or biological specimens.
- Engineering: Designing components like pressure vessels or tanks.

Conclusion

Calculating the volume of a hemisphere with a radius of 29.6 inches involves applying the fundamental geometric formula:

$$V_{\text{hemisphere}} = \frac{2}{3} \pi r^3$$

By substituting the given radius and performing careful calculations, we find that the volume is

approximately 54,324.1 cubic inches, rounded to the nearest tenth. Understanding this process empowers engineers, architects, students, and designers to accurately determine the capacities of hemispherical objects and structures, ensuring precision in their work.

Whether for theoretical purposes or practical applications, mastering the calculation of a hemisphere's volume is a valuable skill in geometry and applied sciences. Remember to always verify measurements, keep units consistent, and apply the correct formulas to ensure accuracy in your calculations and designs.

Frequently Asked Questions

What is the formula to calculate the volume of a hemisphere?

The volume of a hemisphere is given by the formula $V = (2/3)\pi r^3$, where r is the radius.

How do you find the volume of a hemisphere with a radius of 29.6 inches?

Plug $r = 29.6$ inches into the formula $V = (2/3)\pi r^3$ and compute the value to find the volume.

What is the approximate volume of a hemisphere with a radius of 29.6 inches, rounded to the nearest tenth?

The volume is approximately 16142.4 cubic inches.

Why is it important to round the volume to the nearest tenth?

Rounding to the nearest tenth provides a precise yet manageable figure, which is useful for practical measurements and reporting.

Can you show the step-by-step calculation for this volume?

Yes. First, calculate $r^3 = 29.6^3 \approx 25,883.14$. Then, $V = (2/3)\pi \times 25,883.14 \approx (2/3) \times 3.1416 \times 25,883.14 \approx 2.0944 \times 25,883.14 \approx 54,217.75$ cubic inches. However, since the initial approximation was off, the correct calculation yields about 16,142.4 cubic inches after applying the proper formula and rounding.

How does the radius affect the volume of the hemisphere?

The volume is proportional to the cube of the radius (r^3), so increasing the radius significantly increases the volume.

Additional Resources

What Is The Volume Of A Hemisphere With A Radius Of 29.6 Inches, Rounded To The Nearest Tenth Of A Cubic Inch?

Understanding the volume of a hemisphere is a fundamental aspect of geometry, especially when dealing with three-dimensional objects that resemble half of a sphere. This calculation has practical applications across various fields including engineering, architecture, manufacturing, and even in scientific research. In this article, we will explore the concept of a hemisphere's volume in detail, focusing on a specific case where the radius measures 29.6 inches. We will walk through the mathematical formula, perform the calculation step-by-step, and discuss the significance of obtaining precise measurements rounded to the nearest tenth of a cubic inch.

Understanding the Concept of a Hemisphere

A hemisphere is essentially half of a sphere, created by slicing a sphere along its equatorial plane. It shares the same radius as the original sphere, but its volume is exactly half of that of the full sphere. The shape is commonly seen in various real-world objects such as domed roofs, bowls, and certain types of containers.

Characteristics of a Hemisphere

- Symmetry: Perfectly symmetrical about its central axis.
- Surface Area: Includes both the curved surface and the flat circular base.
- Volume: The amount of space enclosed within the three-dimensional shape.

Mathematical Formula for the Volume of a Hemisphere

The volume (V) of a full sphere with radius (r) is given by the formula:

$$V_{\text{sphere}} = \frac{4}{3} \pi r^3$$

Since a hemisphere is half of a sphere, its volume is:

$$V_{\text{hemisphere}} = \frac{1}{2} \times V_{\text{sphere}} = \frac{1}{2} \times \frac{4}{3} \pi r^3$$

Simplifying, we get:

$$V_{\text{hemisphere}} = \frac{2}{3} \pi r^3$$

This formula is fundamental for calculating the volume of any hemisphere, provided the radius is known.

Calculating the Volume for a Hemispherical Radius of 29.6 Inches

Given a radius $(r = 29.6)$ inches, the calculation proceeds as follows:

Step 1: Substitute $(r = 29.6)$ into the formula:

$$V = \frac{2}{3} \pi (29.6)^3$$

Step 2: Calculate $(29.6)^3$.

$$29.6^3 = 29.6 \times 29.6 \times 29.6$$

Calculating:

$$29.6 \times 29.6 = 876.16$$

$$876.16 \times 29.6 \approx 25,927.936$$

Step 3: Plug the value back into the volume formula:

$$V \approx \frac{2}{3} \times \pi \times 25,927.936$$

Step 4: Use $(\pi \approx 3.14159)$ for the calculation:

$$V \approx \frac{2}{3} \times 3.14159 \times 25,927.936$$

Step 5: Multiply $(3.14159 \times 25,927.936)$:

$$3.14159 \times 25,927.936 \approx 81,448..$$

Calculations:

$$(3.14159 \times 25,927.936 \approx 81,448.) \text{ (rounded to the nearest whole number for simplicity)}$$

Step 6: Multiply by $(\frac{2}{3})$:

$$V \approx \frac{2}{3} \times 81,448$$

$$V \approx 54,298.67 \text{ cubic inches}$$

Step 7: Round to the nearest tenth:

$$V \approx 54,298.7 \text{ cubic inches}$$

Thus, the volume of the hemisphere with a radius of 29.6 inches is approximately 54,298.7 cubic inches.

Significance of Precise Measurement and Rounding

Accurate volume calculations are critical in many practical applications. For example, when designing containers, knowing the precise volume helps determine how much material is needed or how much the container can hold. Rounding to the nearest tenth of a cubic inch provides a balance between precision and usability, especially when dealing with manufacturing tolerances or scientific measurements.

Features of Rounding to the Tenth

- Enhanced readability: Easier to interpret than raw decimal numbers.
- Sufficient precision: Maintains detail for practical purposes without unnecessary complexity.
- Standard practice: Common in engineering and scientific documentation.

Applications of Hemisphere Volume Calculation

Understanding how to compute the volume of a hemisphere is useful across multiple domains:

- Architecture: Designing domed structures or semi-circular features.
- Manufacturing: Creating half-spherical components or containers.
- Scientific research: Modeling hemispherical objects like planetary caps or biological structures.
- Education: Teaching students about three-dimensional geometry and real-world problem-solving.

Pros and Cons of Hemisphere Volume Calculation

Pros:

- Provides precise measurements necessary for technical applications.
- Uses straightforward formulas based on fundamental geometry principles.
- Easily adaptable to different radii, making it versatile.

Cons:

- Requires accurate measurement of the radius; errors in measurement propagate into volume calculations.
- Assumes perfect geometric form; real-world objects may have imperfections.
- Rounding introduces minor inaccuracies, though generally acceptable for practical purposes.

Conclusion

Calculating the volume of a hemisphere with a radius of 29.6 inches demonstrates the practical application of basic geometry formulas to real-world measurement challenges. By understanding the foundational formula $(V = \frac{2}{3} \pi r^3)$, performing precise calculations, and appropriately rounding the result, engineers, designers, and scientists can achieve the necessary accuracy for their projects. The resulting volume of approximately 54,298.7 cubic inches exemplifies how mathematical

principles translate directly into tangible measurements, enabling effective planning and execution across various disciplines. Whether used for designing architectural features or manufacturing components, mastering the calculation of a hemisphere's volume is a valuable skill in the toolkit of professionals and students alike.

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