

What Is The Volume (in Cm^3) Of A 25.2 G Piece Of Metal With A Density Of 8.75 G/cm3?

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Understanding the relationship between mass, volume, and density is fundamental in physics and materials science. In this article, we will explore how to calculate the volume of a metal piece given its mass and density. Specifically, we will determine the volume in cubic centimeters (cm³) of a 25.2-gram piece of metal that has a density of 8.75 grams per cubic centimeter (g/cm³). This example illustrates the practical application of the density formula and offers insight into how material properties influence physical measurements.

Understanding Density, Mass, and Volume

What Is Density?

Density is a physical property that indicates how much mass is contained within a given volume of a material. It is expressed mathematically as:

$$\text{Density } (\rho) = \frac{\text{Mass } (m)}{\text{Volume } (V)}$$

where:

- ρ is the density (g/cm³)
- m is the mass (g)
- V is the volume (cm³)

High-density materials have more mass packed into a smaller volume, while low-density materials are more spread out.

Relevance of Density in Calculations

By knowing any two of the three variables—mass, volume, or density—you can calculate the third. This is particularly useful in fields such as materials science, engineering, and chemistry, where understanding the physical properties of materials is essential.

Calculating Volume from Mass and Density

The Formula

The relationship between mass, volume, and density can be rearranged to solve for volume:

$$V = \frac{m}{\rho}$$

Where:

- V is the volume in cubic centimeters (cm^3)
- m is the mass in grams (g)
- ρ is the density in grams per cubic centimeter (g/cm^3)

Applying the Formula to Our Example

Given:

- Mass (m) = 25.2 g
- Density (ρ) = 8.75 g/cm^3

Calculation:

$$V = \frac{25.2 \text{ g}}{8.75 \text{ g}/\text{cm}^3}$$

Performing the division:

$$V \approx 2.88 \text{ cm}^3$$

Therefore, the volume of the metal piece is approximately 2.88 cubic centimeters.

Step-by-Step Guide to Calculating Volume

Step 1: Write Down Known Values

- Mass: 25.2 g

- Density: 8.75 g/cm³

Step 2: Use the Volume Formula

$$V = \frac{m}{\rho}$$

Step 3: Substitute Known Values

$$V = \frac{25.2}{8.75}$$

Step 4: Perform the Calculation

Using a calculator:

$$V \approx 2.88, \text{ cm}^3$$

Step 5: Interpret the Result

The metal piece occupies approximately 2.88 cubic centimeters of space.

Additional Considerations in Volume Calculations

Significance of Units

Ensure that mass is in grams and density in g/cm³ to keep units consistent. If different units are used, convert them accordingly before calculations.

Precision and Rounding

The calculated volume is approximate and depends on the precision of the input values. When reporting results, consider appropriate significant figures.

Implications of Density Variations

Different metals have varying densities. For example:

- Aluminum: approximately 2.70 g/cm^3
- Copper: approximately 8.96 g/cm^3
- Gold: approximately 19.32 g/cm^3

Knowing the density helps identify materials and calculate their properties accurately.

Practical Applications of Volume Calculation

Material Identification

By measuring the mass and calculating the volume, one can determine the density and compare it to known values to identify the material.

Design and Manufacturing

Engineers can calculate the volume of materials needed for manufacturing parts, ensuring proper fit and function.

Density-Related Quality Control

Manufacturers often verify material densities to ensure quality and consistency in production.

Summary

Calculating the volume of a piece of metal when given its mass and density is straightforward using the fundamental relationship $V = \frac{m}{\rho}$. In our example, a 25.2 g piece of metal with a density of 8.75 g/cm^3 has a volume of approximately 2.88 cm^3 . This calculation is essential across various scientific and industrial fields, providing insights into the physical properties of materials and aiding in practical applications such as material selection, quality control, and design.

Key Takeaways

- Density links mass and volume; knowing two allows the calculation of the third.
- Always ensure units are consistent before performing calculations.

- Real-world applications of these calculations include material identification, manufacturing, and quality assurance.
- Approximate volume for the given data: 2.88 cm^3 .

By mastering these basic principles, students and professionals can better understand material properties and apply this knowledge in practical scenarios.

Meta Description: Learn how to calculate the volume of a metal piece given its mass and density. This step-by-step guide explains the formula and provides an example calculation for a 25.2 g piece of metal with a density of 8.75 g/cm^3 .

Frequently Asked Questions

How do you calculate the volume of a metal object given its mass and density?

You use the formula $\text{volume} = \text{mass} / \text{density}$. Divide the mass of the object by its density to find its volume.

What is the volume in cubic centimeters of a 25.2 g piece of metal with a density of 8.75 g/cm^3 ?

The volume is approximately 2.88 cm^3 , calculated by dividing 25.2 g by 8.75 g/cm^3 .

Why is density important when calculating the volume of a material?

Density relates mass to volume; knowing the density allows you to determine the volume when the mass is known, especially for irregular objects.

Can the formula for volume be applied to any material, and what units should be used?

Yes, the formula applies to all materials, but ensure that mass and density are in compatible units, typically grams and grams per cubic centimeter for this calculation.

What are typical units used for density in such calculations?

Density is commonly expressed in grams per cubic centimeter (g/cm^3) or kilograms per cubic meter

(kg/m^3), depending on the context.

If the density of the metal increased, how would that affect the volume of the same mass?

An increase in density would decrease the volume, since $\text{volume} = \text{mass} / \text{density}$; higher density means the material occupies less space for the same mass.

Additional Resources

Volume

Understanding the relationship between mass, density, and volume is fundamental in fields ranging from materials science and engineering to everyday practical applications. When analyzing a piece of metal, especially in contexts such as manufacturing, quality control, or scientific research, knowing its volume can provide critical insights into its properties and suitability for various uses. In this article, we will explore how to determine the volume of a metallic object when given its mass and density, using a specific example: a 25.2 g piece of metal with a density of 8.75 g/cm^3 .

Understanding the Core Concepts: Mass, Density, and Volume

Before diving into calculations, it's essential to understand the fundamental concepts involved:

Mass

- The amount of matter in an object.
- Typically measured in grams (g) or kilograms (kg).
- In our example: 25.2 grams.

Density

- The measure of how much mass is contained within a given volume.
- Expressed in grams per cubic centimeter (g/cm^3) or kilograms per cubic meter (kg/m^3).
- In our example: 8.75 g/cm^3 .

Volume

- The amount of space an object occupies.
- Measured in cubic centimeters (cm³), liters, or cubic meters (m³).
- Our goal: find this for the given metal piece.

The key relationship connecting these quantities is the formula:

$$\rho = \frac{m}{V}$$

or rearranged as:

$$V = \frac{m}{\rho}$$

This fundamental equation is the backbone of our analysis.

Calculating the Volume: Step-by-Step Process

Given the mass and density, calculating the volume involves straightforward algebra, but understanding each step ensures clarity and accuracy.

Step 1: Write down the known quantities

- Mass $(m = 25.2, \text{g})$
- Density $(\rho = 8.75, \text{g/cm}^3)$

Step 2: Recall the formula

$$V = \frac{m}{\rho}$$

Step 3: Substitute the known values into the formula

$$V = \frac{25.2 \text{ g}}{8.75 \text{ g/cm}^3}$$

Step 4: Perform the calculation

Dividing 25.2 by 8.75:

$$V = 2.88 \text{ cm}^3$$

This result indicates that the piece of metal occupies approximately 2.88 cubic centimeters of space.

Interpreting the Result: Practical Implications

The calculated volume of 2.88 cm³ provides a tangible measure of the physical size of the metal piece. To put this into perspective:

- Size comparison: A standard sugar cube is approximately 1 cm x 1 cm x 1 cm, so our metal piece is roughly three times the volume of such a cube.
- Material characteristics: Given the density (8.75 g/cm³), this material is relatively dense, suggesting it could be a metal like aluminum alloy or a similar lightweight metal, depending on the specific alloy composition.
- Design and manufacturing considerations: Knowing the volume helps in designing components, calculating material costs, and assessing weight-related performance factors.

Additional Factors to Consider in Real-world Applications

While the calculation appears straightforward, real-world scenarios often involve additional complexities:

Purity and Alloy Composition

- Real metals are often alloys, and slight variations in composition can affect density.
- Precise density measurements are crucial for high-precision applications.

Measurement Accuracy

- The accuracy of the mass measurement directly influences the volume calculation.
- Using calibrated scales ensures reliable data.

Temperature and Environmental Conditions

- Density can vary with temperature due to thermal expansion or contraction.
- For precise calculations, temperature should be considered or controlled.

Shape and Size Constraints

- Knowing the volume is useful, but understanding the shape helps in manufacturing and fitting processes.
- Volume alone doesn't specify the shape, which could influence how the metal piece is handled or processed.

Related Calculations and Applications

Understanding how to determine volume from mass and density opens doors to several related calculations:

1. Determining Mass from Volume and Density

- If the volume is known, the mass can be calculated as:

$$\begin{aligned} &\backslash[\\ m &= \rho \times V \\ &\backslash] \end{aligned}$$

2. Calculating Density When Mass and Volume Are Known

- Rearranged as:

$$\backslash[$$

$$\rho = \frac{m}{V}$$

3. Material Identification

- Given the mass and volume, density can be used to identify the material, as different metals have characteristic densities.

4. Cost Estimations

- Knowing the volume allows for material cost calculations based on price per unit volume or weight.

Summary: The Significance of Accurate Volume Calculation

Determining the volume of a metal piece from its mass and density is a fundamental skill with diverse applications. In our specific example, a 25.2 g piece with a density of 8.75 g/cm³ has a volume of approximately 2.88 cm³. This calculation not only aids in understanding the physical properties of the material but also plays a vital role in manufacturing, quality assurance, and scientific research.

By mastering this relationship, professionals and enthusiasts alike can make more informed decisions regarding material selection, cost estimation, and product design, ensuring optimized performance and resource utilization.

In conclusion, the ability to accurately compute volume from mass and density is a vital aspect of material science and engineering. Whether you're designing precision components, evaluating materials, or conducting scientific experiments, understanding these fundamental relationships empowers you to make smarter, data-driven decisions.

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