

A Cylindrical Glass Is Shown At Right. The Height Of The Cup Is 7 Inches. The Radius Of the Base Is 1.5

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Understanding the dimensions and properties of cylindrical objects, such as glasses, is essential not only in everyday life but also in fields like engineering, design, and manufacturing. Whether you're measuring for a new glassware set, designing a custom cup, or studying geometric shapes in mathematics, having a clear grasp of the measurements involved is invaluable. In this article, we will explore the various aspects of a cylindrical glass with a height of 7 inches and a base radius of 1.5 inches, delving into its geometry, volume, surface area, practical applications, and more.

Introduction to Cylindrical Geometry

Cylinders are three-dimensional shapes characterized by two parallel circular bases connected by a curved surface. They are common in everyday objects like cans, glasses, pipes, and batteries. Understanding the geometric properties of cylinders can help in various practical scenarios, such as calculating capacity, material requirements, and manufacturing specifications.

Basic Components of a Cylinder

- Height (h): The perpendicular distance between the two bases.
- Radius (r): The radius of the circular base.
- Diameter (d): Twice the radius ($d = 2r$).
- Circumference of the base: The perimeter of the circular base ($C = 2\pi r$).
- Surface Area: The total area covering the cylinder, including the sides and bases.
- Volume: The capacity or space enclosed within the cylinder.

Examining the Dimensions of the Given Cylindrical Glass

Given dimensions:

- Height (h): 7 inches

- Radius of the base (r): 1.5 inches

These measurements define the size and capacity of the glass, as well as its physical properties.

Visualizing the Glass

Imagine a standard drinking glass that is relatively tall and slender. With a height of 7 inches, it's slightly taller than average, providing ample space for liquids. The radius of 1.5 inches indicates a moderate width, making it suitable for various beverages.

Calculating the Volume of the Cylindrical Glass

The volume of a cylinder is essential for understanding how much liquid it can hold.

Formula for Volume

$$V = \pi r^2 h$$

Where:

- V = volume
- r = radius of the base
- h = height
- $\pi \approx 3.1416$

Applying the Dimensions

$$V = 3.1416 \times (1.5)^2 \times 7$$
$$V = 3.1416 \times 2.25 \times 7$$
$$V = 3.1416 \times 15.75$$

$$V \approx 49.48 \text{ cubic inches}$$

Practical Interpretation:

The cylindrical glass can hold approximately 49.48 cubic inches of liquid. To convert this to more familiar units:

- Fluid ounces:

1 cubic inch $\approx$ 0.554 fluid ounces

$$49.48 \times 0.554 \approx 27.4 \text{ fl oz}$$

- Pints:

1 pint $\approx$ 16 fl oz

$$27.4 \div 16 \approx 1.71 \text{ pints}$$

Conclusion:

This glass can hold roughly 1.7 pints or about 27.4 fluid ounces of liquid, making it ideal for standard servings of beverages.

Surface Area of the Cylindrical Glass

Understanding the surface area provides insight into material requirements for manufacturing or cleaning purposes.

Surface Area Formula

$$A = 2\pi r h + 2\pi r^2$$

Where:

- $(2\pi r h)$ = lateral surface area (the side)
- $(2\pi r^2)$ = area of the two circular bases

Calculations

- Lateral surface area:

$$2 \times 3.1416 \times 1.5 \times 7 = 2 \times 3.1416 \times 10.5 = 2 \times 32.986 = 65.97 \text{ sq inches}$$

- Area of the two bases:

$$2 \times 3.1416 \times (1.5)^2 = 2 \times 3.1416 \times 2.25 = 2 \times 7.0686 = 14.137 \text{ sq inches}$$

- Total surface area:

$$65.97 + 14.137 \approx 80.11 \text{ sq inches}$$

Implication:

Approximately 80.11 square inches of material is needed to cover the entire surface of the glass, which is useful information for manufacturing, coating, or cleaning considerations.

Additional Geometric Properties

Beyond volume and surface area, other properties can be explored to deepen understanding.

Curved Surface Area

- The lateral surface area, which is the area of the side of the cylinder, is approximately 65.97 sq inches.
- This is particularly useful when calculating the amount of material needed to wrap around the glass or for painting.

Base Area

- The area of a single base:

$$\pi r^2 = 3.1416 \times 2.25 \approx 7.07 \text{ sq inches}$$

- Since there are two bases, total base area:

$$2 \times 7.07 \approx 14.14 \text{ sq inches}$$

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Practical Applications of the Cylinder's Measurements

Understanding these measurements extends beyond theoretical calculations to practical uses:

Design and Manufacturing

- Material estimation: Knowing the surface area helps determine how much material is needed for manufacturing the glass.
- Capacity planning: Volume calculations ensure the glass meets specific serving or storage requirements.

Scientific and Educational Purposes

- Demonstrating geometric principles in classroom settings.
- Conducting experiments related to fluid dynamics, such as flow rates and capacity.

Everyday Use and Customization

- Choosing the right glass for specific beverages.
- Designing custom glasses with unique dimensions for aesthetic or functional purposes.

Additional Considerations

While the given dimensions are straightforward, real-world scenarios may involve additional factors:

- **Material thickness:** Actual glass thickness affects the internal volume.
- **Shape variations:** Some glasses may have tapered sides or decorative elements.
- **Liquid level:** Fill lines or maximum fill capacity should consider space for ice or garnishes.

Conclusion

A cylindrical glass with a height of 7 inches and a radius of 1.5 inches encapsulates fundamental geometric principles that are widely applicable in various fields. Its volume of approximately 49.48 cubic inches (around 27.4 fluid ounces) makes it suitable for typical beverage servings. The surface area, roughly 80.11 square inches, informs material and manufacturing considerations. Understanding these measurements facilitates better design, efficient manufacturing, and practical usage.

Whether you're a student learning about cylinders, a designer creating custom glassware, or a manufacturer estimating material costs, these calculations and insights provide a comprehensive understanding of cylindrical objects with specified dimensions. Mastery of these concepts enhances accuracy and efficiency in real-world applications involving cylindrical shapes.

Remember: Precise measurements and calculations ensure optimal design, functionality, and aesthetic appeal in any cylindrical object, making the knowledge of geometry an invaluable tool in everyday and professional contexts.

Frequently Asked Questions

What is the volume of the cylindrical glass with a height of 7 inches and a radius of 1.5 inches?

The volume $V = \pi r^2 h = \pi \times (1.5)^2 \times 7 \approx 3.1416 \times 2.25 \times 7 \approx 49.48$ cubic inches.

How much liquid can the cylindrical glass hold in ounces?

Since 1 cubic inch ≈ 0.554 fluid ounces, the glass can hold approximately $49.48 \times 0.554 \approx 27.45$ ounces.

What is the surface area of the cylindrical glass?

Surface area $= 2\pi r(h + r) = 2 \times 3.1416 \times 1.5 \times (7 + 1.5) \approx 2 \times 3.1416 \times 1.5 \times 8.5 \approx 80.11$ square inches.

If the glass is filled to the brim, what is the height of the liquid if the

radius is increased to 2 inches?

To find the new height with radius 2 inches for the same volume of 49.48 cubic inches: $h = V / (\pi r^2) = 49.48 / (3.1416 \times 4) \approx 49.48 / 12.566 \approx 3.94$ inches.

What is the lateral surface area of the cylindrical glass?

Lateral surface area = $2\pi rh = 2 \times 3.1416 \times 1.5 \times 7 \approx 65.97$ square inches.

How long would it take to fill the glass with water flowing at 2 inches per second from a hose?

Volume of the glass is approximately 49.48 cubic inches. Flow rate in cubic inches per second = cross-sectional area of the hose $\times$ flow speed. Assuming the hose has a 0.5-inch radius: area = $\pi \times 0.5^2 \approx 0.785$ sq inches. Flow rate = $0.785 \times 2 \approx 1.57$ cubic inches/sec. Time to fill = $49.48 / 1.57 \approx 31.5$ seconds.

What is the diameter of the base of the glass?

The diameter is twice the radius, so 2×1.5 inches = 3 inches.

If the glass is tilted at an angle, what is the maximum tilt angle before spilling occurs?

The maximum tilt angle depends on the liquid's surface level and the shape of the glass. For a cylindrical glass, the tilt angle before spilling can be approximated by considering the height and radius; typically, the maximum tilt before spillage occurs when the liquid reaches the rim, which requires more specific calculations based on the tilt axis.

How does increasing the height of the glass affect its volume and capacity?

Increasing the height of the glass proportionally increases its volume and capacity, since volume = $\pi r^2 h$. Doubling the height doubles the volume, assuming the radius remains constant.

Additional Resources

A Cylindrical Glass: An In-Depth Exploration of Design, Dimensions, and Functionality

The cylindrical glass presented here exemplifies a classic design that balances simplicity with practicality. With a height of 7 inches and a base radius of 1.5 inches, this vessel offers a compelling case study in geometric proportions, material considerations, and everyday utility. In this article, we will delve into the

details of its dimensions, explore the mathematical and physical implications of its shape, and analyze its role in various contexts—from beverage serving to design aesthetics.

Understanding the Dimensions: Height and Radius

Basic Specifications

At the core of this cylindrical glass are two fundamental measurements:

- Height (h): 7 inches
- Radius of the base (r): 1.5 inches

These dimensions influence not only the volume and capacity of the glass but also its stability, ergonomic handling, and visual appeal.

Implications of the Height

The 7-inch height positions this glass as a medium-to-tall vessel, ideal for serving a variety of beverages, from water and juice to cocktails and smoothies. The height affects:

- Visual Presence: A taller glass creates an elegant silhouette, especially when filled with colorful liquids.
- Volume Capacity: The height directly influences how much liquid the glass can hold, which we will analyze further in subsequent sections.
- Handling and Usability: While taller glasses can be aesthetically pleasing, they may require careful handling to prevent tipping, especially if the base isn't sufficiently weighted.

Significance of the Radius

With a radius of 1.5 inches, the diameter of the base is 3 inches. This measurement impacts:

- Stability: A wider base provides a lower center of gravity, enhancing stability.
- Capacity: The radius determines the cross-sectional area, influencing total volume.
- Design Aesthetics: A proportionate radius relative to height lends a balanced look, which is often preferred in glassware design.

Calculating the Volume and Capacity

The Mathematical Formula

The volume (V) of a cylinder is given by the formula:

$$V = \pi r^2 h$$

where:

- (r) is the radius
- (h) is the height
- (π) is Pi (~ 3.1416)

Applying the Dimensions

Substituting the known values:

$$V = 3.1416 \times (1.5)^2 \times 7$$

Calculating step-by-step:

1. Square the radius:

$$(1.5)^2 = 2.25$$

2. Multiply by the height:

$$2.25 \times 7 = 15.75$$

\]

3. Multiply by Pi:

\[

$15.75 \times 3.1416 \approx 49.48 \text{ cubic inches}$

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Thus, the approximate volume of the glass is 49.48 cubic inches.

Converting to Common Units

For practical purposes, such as understanding capacity in fluid ounces:

- 1 cubic inch $\approx$ 0.554 fluid ounces

Therefore:

\[

$49.48 \text{ in}^3 \times 0.554 \approx 27.4 \text{ fluid ounces}$

\]

Summary: The cylindrical glass can hold approximately 27.4 fluid ounces, making it suitable for a variety of beverages ranging from a standard serving of juice to a generous cocktail.

Design Considerations and Practical Utility

Aesthetic Appeal

The straightforward cylindrical shape is a staple in glassware design. Its clean lines and symmetry evoke modern minimalism, making it adaptable for various settings—from casual dining to upscale bars. The proportions—height versus radius—create an elegant silhouette that emphasizes clarity and simplicity.

Material Selection

Typically made from clear glass, the transparency allows for visual appreciation of the beverage's color and presentation. Material considerations include:

- Durability: Thickened glass can withstand daily use.
- Clarity: High-quality glass ensures a crisp, transparent appearance.
- Thermal Conductivity: Glass insulates well, maintaining beverage temperature.

Functionality and Ergonomics

The dimensions influence how comfortably the glass can be held:

- Grip: The 1.5-inch radius provides a manageable circumference (~9.42 inches), accommodating various hand sizes.
- Pouring and Drinking: The height offers sufficient space for garnishes, ice, or layered drinks without spilling.

Stability and Safety Factors

Center of Gravity and Tipping Risk

A taller, slender glass may be more prone to tipping if not properly weighted at the base. The radius and material weight contribute to the overall stability:

- Base Size: The 1.5-inch radius yields a 3-inch diameter, providing a broad enough footprint to prevent accidental tipping.
- Material Weight: Heavier glass or added weight at the base enhances stability.

Design Enhancements for Safety

Manufacturers often incorporate features such as:

- **Weighted Bases:** To lower the center of gravity.
- **Textured Bottoms:** To prevent slipping on surfaces.
- **Thickened Edges:** To withstand impacts and reduce breakage risk.

Applications and Contexts

Commercial and Home Use

This cylindrical glass's versatile size and shape make it suitable for:

- **Restaurants and Bars:** For serving cocktails, spirits, or water.
- **Home Settings:** For everyday beverages, parties, or special occasions.

Cultural and Aesthetic Variations

Depending on cultural preferences and presentation styles, the same dimensions can be adapted for:

- **Decorative Purposes:** Filling with decorative stones or layered drinks.

- Themed Events: Custom engravings or color accents.

Environmental and Sustainability Considerations

In an era emphasizing sustainability, reusable glassware like this cylindrical vessel reduces waste compared to disposable cups. Its durable design supports eco-friendly practices in hospitality and home environments.

Conclusion: The Significance of Design and Dimensions

The cylindrical glass with a height of 7 inches and a base radius of 1.5 inches exemplifies a well-balanced combination of form and function. Its dimensions not only dictate its volume capacity—approximately 27.4 ounces—but also influence usability, stability, and aesthetic appeal. Such a vessel embodies the principles of good design: simplicity, practicality, and versatility.

From a mathematical perspective, understanding its volume and proportions allows manufacturers and consumers alike to appreciate its utility fully. Whether used for casual hydration or elaborate cocktails, this glass's dimensions make it a reliable and stylish choice. Its design underscores the importance of precise measurements in everyday objects,

subtly enhancing the experience of both serving and enjoying beverages.

In the broader context of product design and functionality, this analysis highlights how thoughtful consideration of dimensions can elevate a simple object to an essential element of daily life, blending practicality with elegance.

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