

Grade 8 - Volume of Cylinders, Cones and Spheres - Lesson

Common Core 8.G.C.9 · maths-pdf.fr/en/

The volume of a cylinder is pi times the radius squared times the height. A cone with the same base and height has one third of that volume, and a sphere of radius r has volume four thirds pi r cubed. Use the radius, not the diameter, and give answers in cubic units.

Grade 8 · Common Core State Standards: **8.G.C.9**

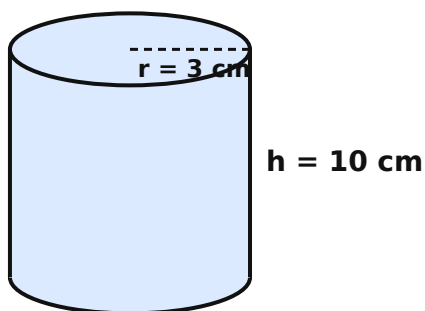
Key facts

- Cylinder: $V = \pi r^2 h$.
- Cone: $V = \frac{1}{3}\pi r^2 h$, one third of the matching cylinder.
- Sphere: $V = \frac{4}{3}\pi r^3$; hemisphere: $\frac{2}{3}\pi r^3$.
- Radius is half the diameter; cube or square the radius before multiplying.
- Doubling the radius multiplies cylinder volume by 4 and sphere volume by 8.

What are the volume formulas?

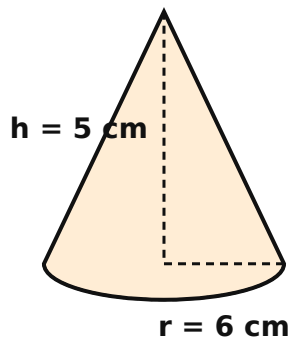
Volume measures how much space a solid takes up, in cubic units. Three formulas cover cylinders, cones and spheres. In each, r is the radius and h is the height.

Solid	Formula	Example
Cylinder	$V = \pi r^2 h$	$r = 3, h = 10: 90\pi$
Cone	$V = \frac{1}{3}\pi r^2 h$	$r = 6, h = 5: 60\pi$
Sphere	$V = \frac{4}{3}\pi r^3$	$r = 3: 36\pi$



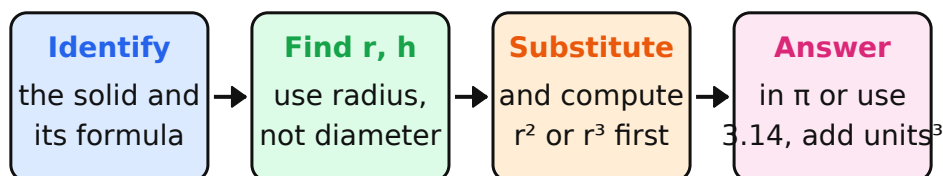
$$V = \pi \times 3^2 \times 10 = 90\pi \text{ cm}^3.$$

A cylinder is a stack of circles. The area of the base circle is πr^2 , and multiplying by the height stacks the circles: $V = \pi r^2 h$. A cone with the same base and height holds exactly one third as much, and a sphere of radius r holds $\frac{4}{3}\pi r^3$.



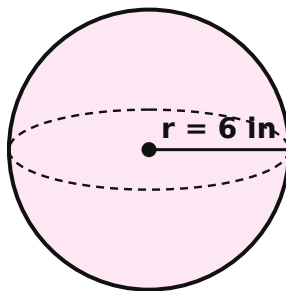
$$V = (1/3) \times \pi \times 6^2 \times 5 = 60\pi \text{ cm}^3.$$

How do you find a volume?



Four steps for any volume.

Worked example. Find the volume of a sphere with diameter 12 inches. The radius is 6 inches, so $V = \frac{4}{3}\pi \cdot 6^3 = \frac{4}{3}\pi \cdot 216 = 288\pi$ cubic inches. Using $\pi \approx 3.14$, $V \approx 904.32$ cubic inches.



$$V = (4/3) \times \pi \times 6^3 = 288\pi \text{ in}^3.$$

How do you work backwards?

If the volume is given, substitute it and solve for the unknown. A cylinder has volume 150π and radius 5, so $150\pi = \pi \cdot 25 \cdot h$, which gives $h = 6$. Doubling the radius of a cylinder multiplies its

volume by $2^2 = 4$, and doubling both radius and height multiplies it by 8.

Many everyday objects are these shapes: a soup can is a cylinder, a traffic cone is a cone, and a basketball is a sphere. Measure the radius or diameter, then choose the matching formula. Remember to use the same units for the radius and the height before you multiply, and write the cubic unit at the end of your answer.

For combined solids, add the volumes. A grain silo made of a cylinder and a hemisphere (half a sphere) has $V = \pi r^2 h + \frac{2}{3} \pi r^3$.

Questions about volume of cylinders, cones and spheres

Why is the cone volume one third of the cylinder?

Filling a cone with sand three times fills a cylinder with the same radius and height. This can be shown with an experiment or with calculus later on.

Should I use the radius or the diameter?

Always use the radius in these formulas. If you are given a diameter, divide it by 2 first.

Should I leave my answer in terms of pi?

Either is fine unless a problem says otherwise. In terms of pi, 36π is exact; with $\pi \approx 3.14$, it is about 113.04.

What units does volume have?

Cubic units such as cubic inches (in^3) or cubic feet (ft^3), because volume measures three dimensions.

How do I find a radius from a volume?

Substitute the volume into the formula and solve. For a sphere, $\frac{4}{3}\pi r^3 = V$ gives r^3 , and then you take a cube root.