

VOLUME

Volume is the amount of space an object or substance takes up or the amount an object or substance can hold.



KEY POINTS

Volume:

- is an aspect of solid geometry
 - solid geometry is three dimensional (3D) because it has height, width and depth.
 - solid geometry shapes have either
 - straight edges, sharp corners and flat sides (e.g. polyhedrons such as cubes, cuboids and pyramids)
 - or some or all surfaces that are not flat (e.g. cylinders, cones and spheres)
- is described in cubic units, e.g., cm^3
- of a cube or cuboid is calculated as: length x width x height (lwh)
 - a cube is a square
 - a cuboid is a rectangle
- of a cylinder is calculated as: area of the base x height
- of a cone is calculated as: $\frac{1}{3}$ of the area of the base x height



Steps

Straight-edged, flat-sided shapes

1. To calculate the volume of a polyhedron, such as a rectangle or square, measure the length, width and height of the shape.
 - height may also be referred to as depth
 - length is always the longest side, if there is one
2. Multiply the measurements using the formula $V = l \times w \times h$
3. Write the answer as a "cubic" number, e.g., 10 cm^3
4. Always include the units of measurement in your answer (in.^3 , cm^3 , etc.)

Curved-surface shapes

Cylinder: a 3D shape with curved sides and a top and bottom that are flat circles

1. Measure the radius and height of the cylinder.
2. Multiply the measurements using the formula $V = \pi r^2 h$
 - πr^2 is the calculation for the area of one end
3. Write the answer as a cubic number, e.g., 10 cm^3
4. Always include the units of measurement in your answer (in.^3 , cm^3 , etc.)

An Important Note about pi

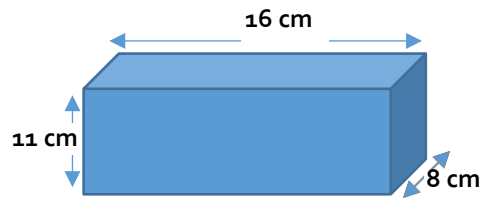
The most accurate way to complete a calculation that includes pi is to use a calculator with the π key option. If you do not have access to this sort of calculator, you can use the value of 3.14 for pi, when practicing. However, 3.14 is not as accurate a measurement and should not be used in work or assessment situations where accuracy is important.

Cone: a 3D shape with a circle at one end, a point at the other and a curved side

1. Measure the radius and height of the cone.
2. Multiply the measurements using the formula $V = \frac{\pi r^2 h}{3}$
3. Write the answer as a cubic number, e.g., 10 cm³
4. Always include the units of measurement in your answer (in.³, cm³, etc.)



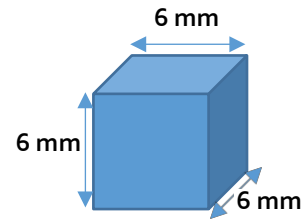
EXAMPLES



$$V = l \times w \times h$$

$$V = 16 \times 8 \times 11$$

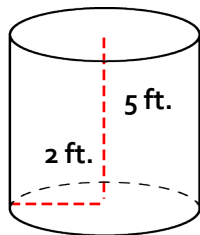
$$V = 1408 \text{ cm}^3$$



$$V = l \times w \times h$$

$$V = 6 \times 6 \times 6$$

$$V = 216 \text{ mm}^3$$



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

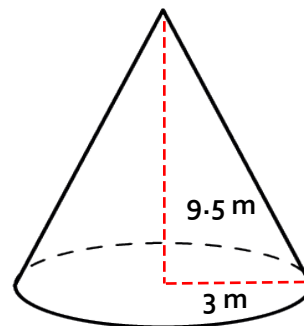
$$V = \pi (2 \times 2) \times 5$$

$$V = 62.83 \text{ ft.}^3$$

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

$$V = 3.14(2 \times 2) \times 5$$

$$V = 62.8 \text{ ft.}^3$$



$$V = \frac{\pi r^2 h}{3}$$

$$V = \pi (3 \times 3) \times 9.5 \div 3$$

$$V = 268.606 \div 3$$

$$V = 89.53 \text{ m}^3$$

$$V = \frac{\pi r^2 h}{3}$$

$$V = 3.14 (3 \times 3) \times 9.5 \div 3$$

$$V = 268.47 \div 3$$

$$V = 89.5 \text{ m}^3$$

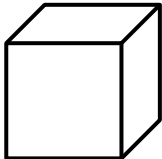
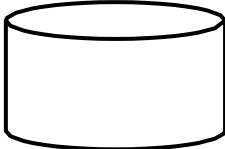
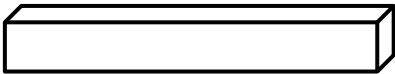
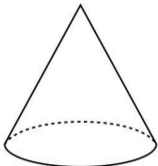

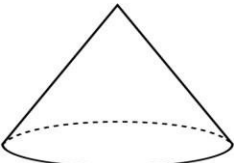
Think you understand how to calculate volume?
Try it yourself on the next page.

USING THE SKILL



In the Workplace: Volume calculations are used for a variety of tasks. As examples, it may be necessary to determine the volume of land to remove or fill to add to a site, or the volume of material trucks can haul. Plumbers and pipefitters calculate the volume of pipe to determine which pipe to use or the best size of hot water tank to install.

Calculate volume for each of the shapes below. Write down the formula you use in each case. Remember to include units in your answers. Round to the nearest tenth if using 3.14 and the nearest hundredth if using pi.

	$l, w, h = 23 \text{ mm}$
	$r = 16 \text{ m}$ $h = 13 \text{ m}$
	$l = 37 \text{ cm}$ $w = 10 \text{ cm}$ $h = 8 \text{ cm}$
	$r = 7 \text{ in.}$ $h = 15 \text{ in.}$
	$r = 12 \text{ m}$ $h = 72 \text{ m}$
	$r = 11 \text{ ft.}$ $h = 11 \text{ ft.}$



REFLECTION

How do you use volume at work? When do you use it?