

What is volume?

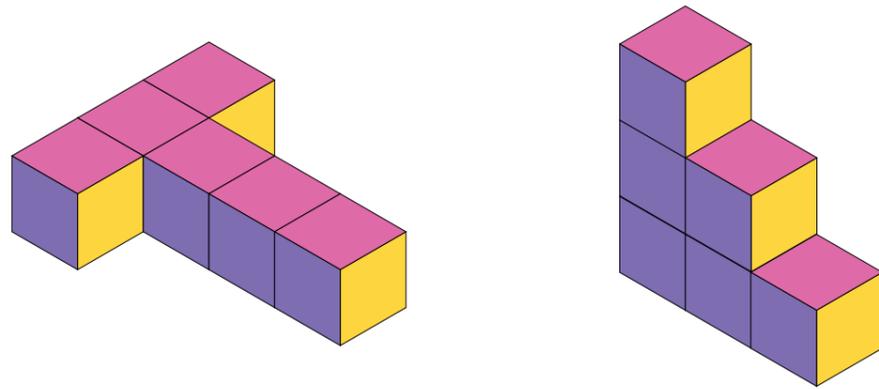
Volume is the amount of space taken up by a three-dimensional shape or substance.

Units of volume

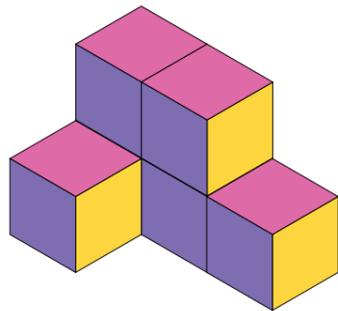
Volume is measured in unit cubes, for example cubic millimetres (mm^3) and cubic metres (m^3). Volume can also be used to measure liquid capacity, for example centilitres (cl) and litres (l).

How to find volume

Volume can be found by **counting cubes**, for example:



Both of these shapes are made from 6 cubes.
Volume = 6 cubes



This shape also has a volume of 6 cubes but one of the cubes cannot be seen.

How to calculate volume of a cube or cuboid

A cube/cuboid is made up from **layers**.

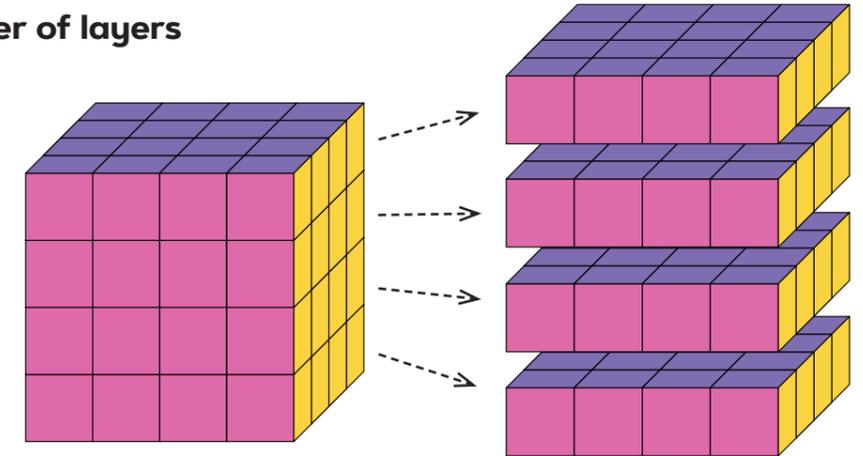
The **volume** of a cube/cuboid can be found using the rule:

Number of cubes in each layer \times **the number of layers**

For example, this cube has 4 layers.

In each layer there are 4 rows, each with 4 small cubes.

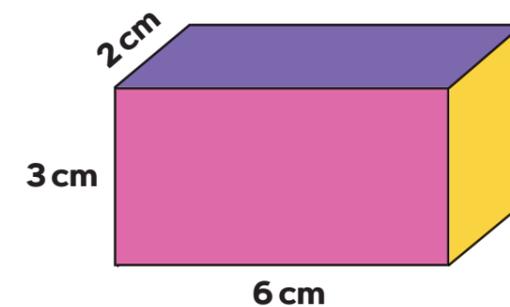
Each layer has $4 \times 4 = 16$ small cubes.



Volume of cube = number of cubes in each layer \times **the number of layers** = $16 \times 4 = 64$ cubes

Another method to calculate the **volume** of a **cube** or **cuboid** is:

- Find the length, the width and height of the cube/cuboid
- Use the rule **volume = length \times width \times height**



Example

This cuboid has **length 6 cm**, **width 2 cm** and **height 3 cm**

Volume = $6 \times 2 \times 3 = 36 \text{ cm}^3$

Level 4

Estimate/Find volume by counting cubes.

Level 5

Calculate volumes of cubes and cuboids.

What is volume?

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Units of volume

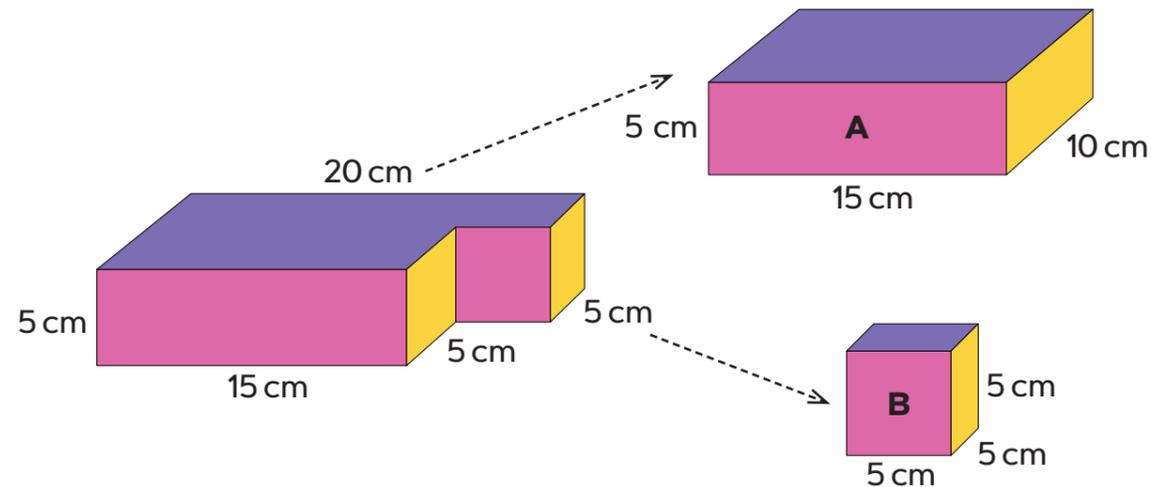
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How to calculate volume of a composite 3-D shape

To calculate the **volume** of a **composite 3-D shape**:

- **Split** the 3-D shape into two or more parts
- Calculate the volume of each part
- Find the **total volume** by **adding** the separate volumes

For example, split this 3-D shape into a cuboid (**A**) and a cube (**B**)



$$\text{Volume of A} = 15 \times 5 \times 10 = 750 \text{ cm}^3$$

$$\text{Volume of B} = 5 \times 5 \times 5 = 125 \text{ cm}^3$$

$$\text{Total volume} = 750 + 125 = 875 \text{ cm}^3$$

How to calculate volume of a prism

A prism is a solid shape with two flat identical faces found at each end. This face is known as the **cross-sectional area**.

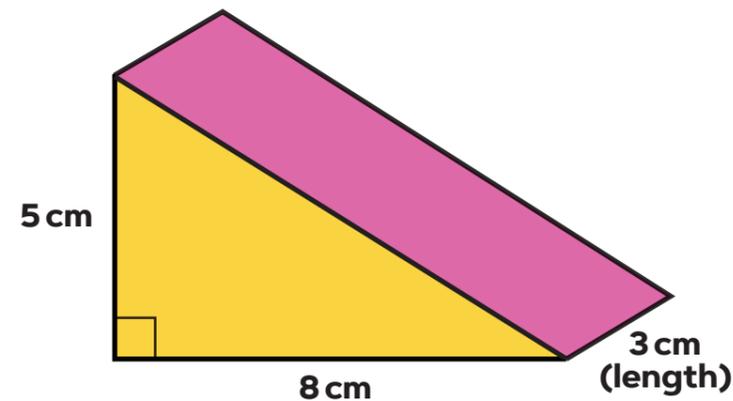
To calculate the **volume** of a **prism**:

- Identify the **cross-sectional area**
- **Calculate** the **area** of the **cross-sectional area**
- **Multiply** the **cross-sectional area** by the **length**

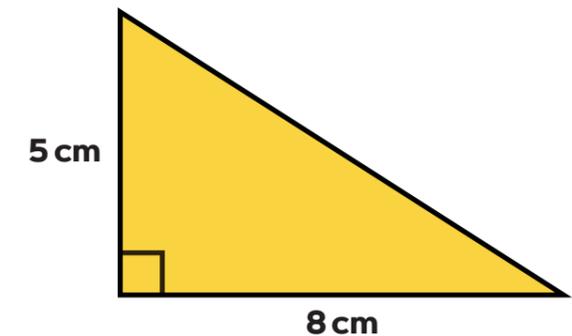
$$\text{Volume of a prism} = \text{cross-sectional area} \times \text{length}$$

Example

Calculate the volume of this **triangular prism**.



The cross-sectional area of this prism is a **right-angled triangle**.



The **area** of the right-angled triangle is $(8 \times 5) \div 2 = 20 \text{ cm}^2$

To find the **volume** multiply the cross-sectional area by the length

$$\text{Volume} = 20 \times 3 = 60 \text{ cm}^3$$

Level 6

Calculate composite volumes of cubes and cuboids.

What is volume?

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Units of volume

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How to calculate volume of a cylinder

To calculate the **volume** of a **cylinder**:

- Calculate the area of the circular face using $A = \pi \times r^2$
- Find the **volume** by multiplying the **area of the face** (cross-sectional area) by the **height**

or

- Use the formula $\text{Volume} = \pi \times r^2 \times h$

π is approximately **3.142**

Example

Radius = 5 cm

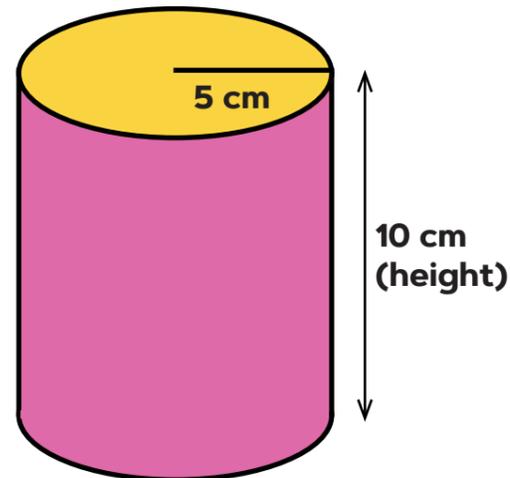
Area of the circular face = $\pi \times 5^2 = 3.142 \times 25 = 78.54 \text{ cm}^2$ (2 d.p.)

Volume = $78.54 \times 10 = 785.4 \text{ cm}^3$

or

Volume = $\pi \times r^2 \times h$

Volume = $\pi \times 5^2 \times 10 = 785.4 \text{ cm}^3$ (1 d.p.)

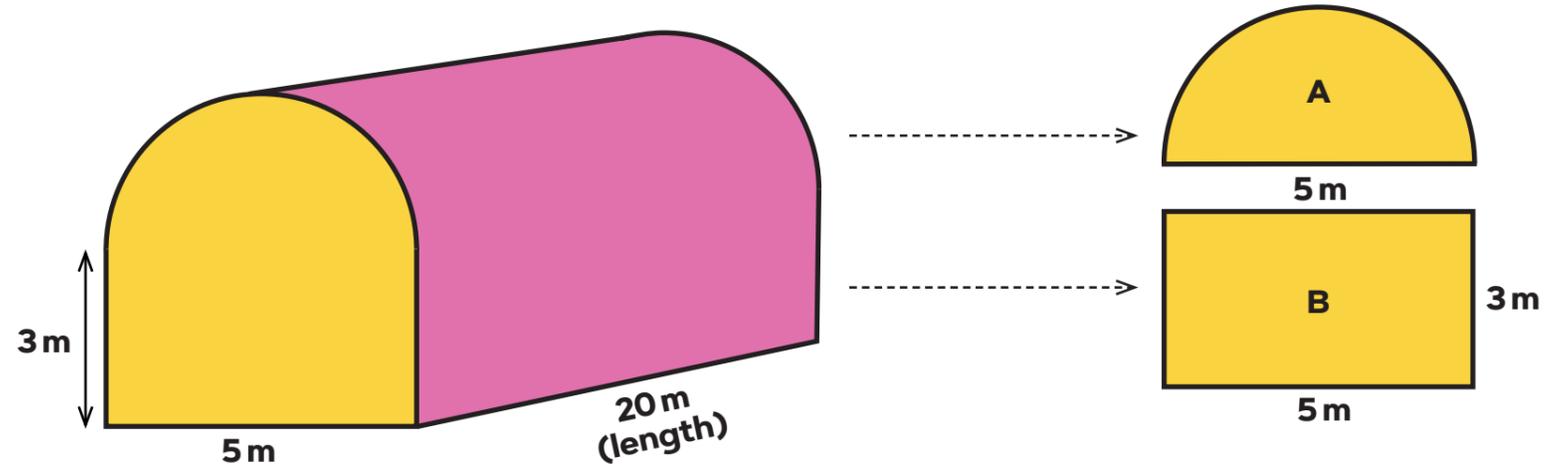


How to calculate volume of a curved prism

To calculate the **volume** of a **curved prism**:

- Identify the **cross-sectional area**
- **Split** the cross-sectional area **into** two or more **2-D shapes**
- **Calculate** the **area** of each 2-D shape
- Find the **total cross-sectional area** by **adding** the areas
- **Multiply** the total cross-sectional area **by the length**

For example, split the cross-sectional area of this curved prism into a semi-circle (**A**) and a rectangle (**B**)



Area of **A** = $(\pi \times 2.5^2) \div 2 = 9.82 \text{ m}^2$ (2 d.p.)

Area of **B** = $5 \times 3 = 15 \text{ m}^2$

Cross-sectional area = $9.82 + 15 = 24.82 \text{ m}^2$

Total volume = $24.82 \times 20 = 496.4 \text{ m}^3$

Level 7

Calculate the volume of a cylinder and curved prism.