

## Volume – Lesson 2

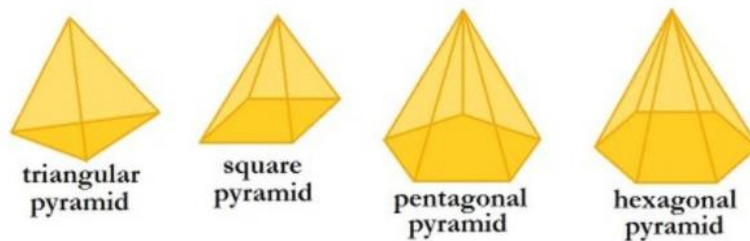
Today we will learn how to find the volume of pyramid and a cone. These formulae will appear on the front of your exam paper so, although you need to know how and when to use them, you don't need to memorise them.

Volume of a cone:  $V = \frac{1}{3}\pi r^2 h$

Volume of a pyramid:  $V = \frac{1}{3}Ah$

We will start with the second formula for the volume of a pyramid.

When you mention a pyramid most of us think of the square-based pyramid but there are many different types of pyramid. In fact, you can build a pyramid on any 2D shape.



The formula for the volume of a pyramid is: -

$$V = \frac{1}{3} \times A \times h$$

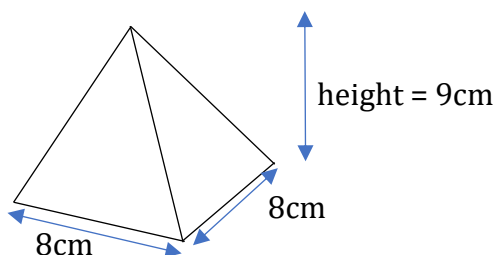
Where: -

**A** is the area of the base of the pyramid

**h** is the height of the pyramid

Example

Calculate the volume of this square-based pyramid.

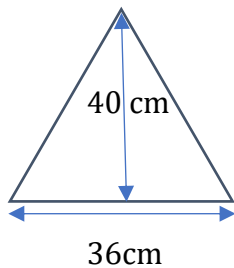


$$\begin{aligned}\text{Area of base} &= l \times b \\ &= 8 \times 8 \\ &= 64\text{cm}^2\end{aligned}$$

$$\begin{aligned}\text{Volume of pyramid} &= \frac{1}{3} \times A \times h \\ &= \frac{1}{3} \times 64 \times 9 \\ &= 192\text{cm}^3\end{aligned}$$

Now calculate the volume of these pyramids: -

- 1) Square base side 12cm, height 8cm.
- 2) Rectangular base 7cm by 9cm, height 10cm
- 3) Triangular base (shown below), height 30cm



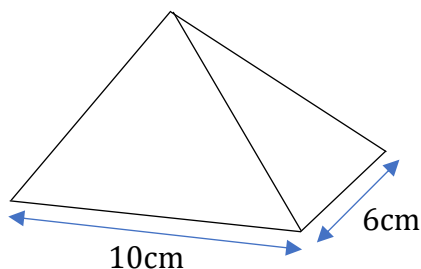
- 4) Hexagonal base with an area of  $300\text{cm}^2$ , height 20cm.
- 5) Circular base radius 6cm, height 15cm. (Round your answer to three significant figures)

Of course, this is a cone...

If you know the area of the base of a pyramid and its volume you can find its height.

Example

The rectangular-based pyramid shown below has a volume of  $140\text{cm}^3$ . Calculate the height of this pyramid.



$$\text{Area of base} = l \times b$$

$$= 10 \times 6$$

$$= 60\text{cm}^2$$

$$\frac{1}{3} \times A \times h = V$$

$$\frac{1}{3} \times 60 \times h = 140$$

$$20 \times h = 140$$

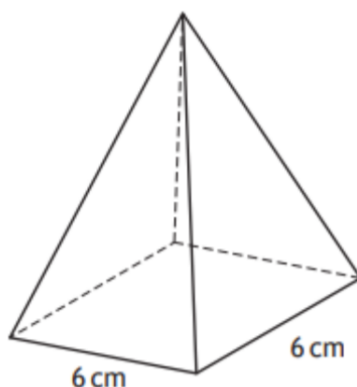
$$h = \frac{140}{20} = 7\text{cm}$$

Click for a video of this explanation. <https://youtu.be/MIJh-Djtfo>

Now solve these problems: -

- 6) A pyramid with a rectangular base has a volume of  $280\text{cm}^3$ . Calculate the height of this pyramid if the dimensions of the base are 12cm by 7cm
- 7) A pyramid with a square base side 17cm has a volume of  $1000\text{cm}^3$ . Calculate the height of this pyramid. Round your answer to three significant figures.
- 8) A pyramid has an octagonal base with an area of  $420\text{cm}^2$ . In order to have a volume of  $2000\text{cm}^3$ , what height should this pyramid have? Round your answer to three significant figures.
- 9) This question is taken from an old National 5 exam paper: -

A square based pyramid is shown in the diagram below.



The square base has length 6 centimetres.

The volume is 138 cubic centimetres.

Calculate the height of the pyramid.

As we saw earlier, a cone is a pyramid with a circular base. The formula for the volume of a cone is: -

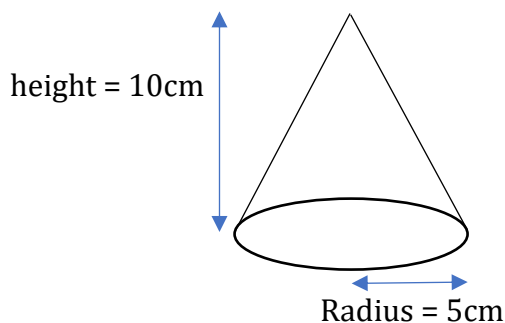
$$V = \frac{1}{3} \times \pi \times r^2 \times h$$

Where: -

**r** is the radius of the circular base

**h** is the height of the cone

Calculate the height of this cone. Round your answer to three significant figures.



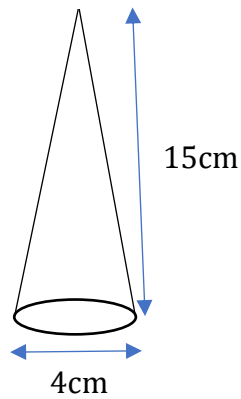
$$\text{Volume} = \frac{1}{3} \times \pi \times r^2 \times h$$

$$= \frac{1}{3} \times 3.1415..... \times 5^2 \times 10$$

$$= 261.7993.....$$

$$\text{Volume} = 262\text{cm}^3 \text{ (rounded to 3 sig. figs.)}$$

Calculate the volume of this cone. Round your answer to two significant figures.



$$\text{Radius} = \frac{1}{2} \times 4 \text{ cm} = 2 \text{ cm}$$

$$\text{Volume} = \frac{1}{3} \times \pi \times r^2 \times h$$

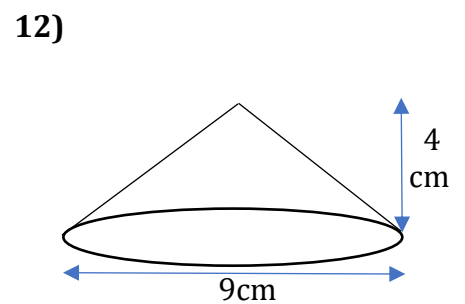
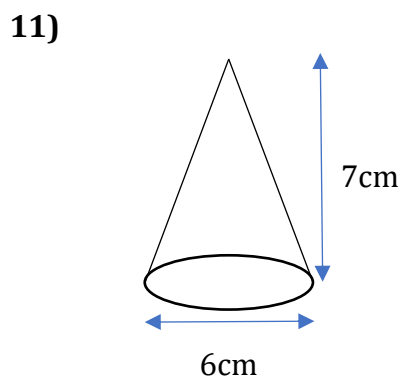
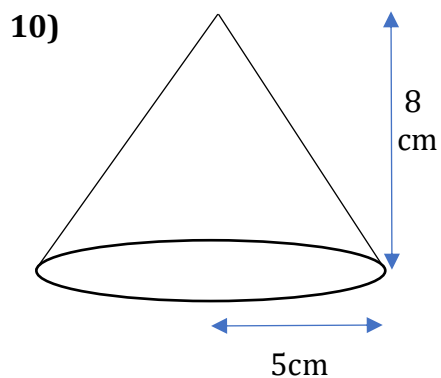
$$= \frac{1}{3} \times 3.14159... \times 2^2 \times 15$$

$$= 62.8318...$$

$$\text{Volume} = 63 \text{ cm}^3 \text{ (rounded to 2 sig. figs.)}$$

Notice that, in the first example, you are given the radius but, in the second example, you are given the diameter, so you must half it to get the radius.

Now calculate the volume of these cones, rounding your answers to three significant figures: -



**13)** Radius 7cm, height 18cm

**14)** Diameter 8cm, height 20cm

**15)** Radius 8cm, height 18cm