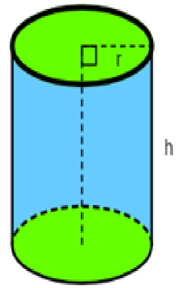
# Knowledge organiser: 3D Shape, Plans & Elevations

## Key Terms

| | |
|---|---|
| Volume | Space inside a 3D shape |
| Surface Area | Total area of all faces of a 3D shape |
| Sphere | A ball shape |
| Prism | A 3D shape with the same cross section throughout its length |
| Plan | Birds eye view of a shape |
| Elevation | A view of a shape |

## 3D shapes

**Why learn this?**
Packaging designers design nets to make up boxes to the shapes they want.



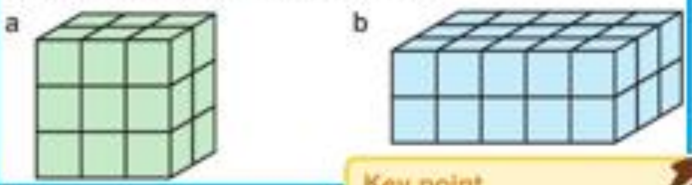

Volume of a Cylinder
$\pi r^2 h$

A **net** is a 2D shape that folds to make a 3D solid.

## Volume of cubes and cuboids

**Key point**
The **volume** of a solid shape is the amount of 3D space it takes up.
The units of volume are **cubic units** (e.g. $mm^3$, $cm^3$ or $m^3$).

Work out the volume of each cuboid.




Count the number of cubes on the top layer, then multiply by the number of layers.

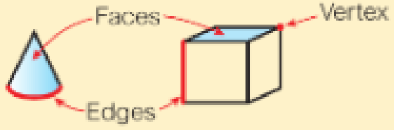
**Key point**
**volume of a cube** = (side length)$^3$
which can be written as $V = l^3$

**Key point**
**volume of a cuboid**
= length × width × height
which can be written as $V = lwh$

**Key point**
You need to convert lengths into the same units before calculating areas or volumes.

$1\,ml = 1\,cm^3$ (×1000 ↓) (↑ ×1000)
$1\,l = 1000\,cm^3$

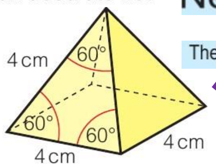
**Key point**
A 3D solid has **faces**, **edges** and **vertices**. Faces and edges can be flat or curved.



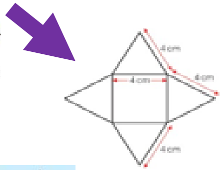

**Vertices** is the plural of **vertex**.

## Nets of 3D solids

Draw an accurate net

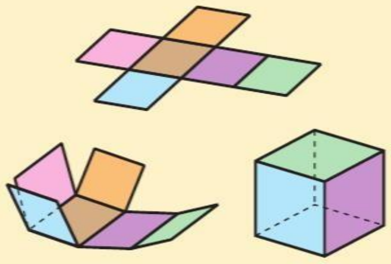



The base of the pyramid is a square.



Use a protractor to draw angles.

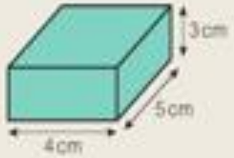
**Key point**
A **net** is a 2D shape that folds up to make a 3D solid.



**Key point**
The **surface area** of a 3D shape is the total area of all its faces.
You can draw a net to help you find the surface area.

## Surface area of cubes and cuboids

**Worked example**
Calculate the surface area of this cuboid.




surface area $= 2(4 \times 5) + 2(4 \times 3) + 2(5 \times 3)$
$= 2 \times 20 + 2 \times 12 + 2 \times 15$
$= 40 + 24 + 30$
$= 94\,cm^2$

There are two of each size face: top and bottom, front and back, left and right sides.

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# Knowledge organiser: 3D Shape, Plans & Elevations

## Converting VOLUME Units

VOLUME is how much 3D space is occupied, and is measured in cubes.

**VOLUME consists of Cube Units, so we need to CUBE all our Lengths.**

$\times 1000^3$   $\times 100^3$   $\times 10^3$

$Km^3$ → $m^3$ → $cm^3$ → $mm^3$

$\div 1000^3$   $\div 100^3$   $\div 10^3$

VOLUME conversions use powers of 3, and usually create very large results.

$3m^3 = ?\ cm^3$   Need to $\times 100^3$   $3 \times 100 \times 100 \times 100 = 3\ 000\ 000\ cm^3$ ✓

### Next Steps

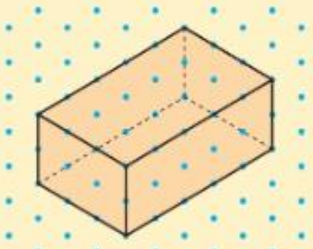
Rearrange the formula given the volume

## Plans and elevations

A plan is like the birds eye view of the shape.
The front is the view as if someone was stood in front of the shape and the side is the view from the side.
The plan, front and side should always be drawn in 2D. If the shape is made from cubes, it must have the correct number of squares in the diagram.

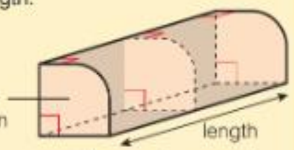
### Key point

3D solids can be drawn on **isometric paper**. This cuboid is 3 units wide, 5 units long and 2 units high.



### Key point

A **prism** is a solid shape that has the same **cross-section** throughout its length.




The cross-section can be any flat shape. It is perpendicular to the length of the solid.

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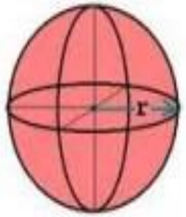
## Year 11 Foundation – 3D shape

Plans and elevations
Volume of sphere, cone and composite shapes
Convert between units of volume.

**Volume of a Sphere = $(4 \div 3) \times pi \times r^3$**




pi = 3.14
r = radius

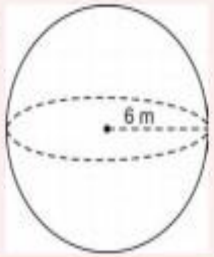
## Volume of a sphere

Using the formula above, you just have to substitute in the radius. For example;

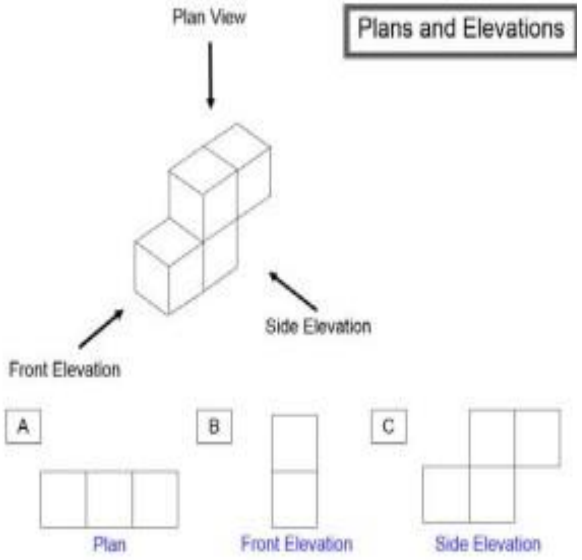
$(4/3 \times \pi \times (6)^3) =$

$4/3 \times \pi \times 216 = 904.\ 78m^3$

You will be given this Formula in the exam.




## Plans and Elevations




## Volume of a Cone

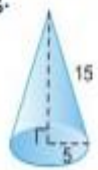
The volume of a cone is given by the following formula:

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

Where r is the radius of the base and $h$ is the perpendicular height of the cone.

Volume = the area of the circle x perpendicular height / 3.

E.g. $\frac{5^2 \times \pi \times 15}{3}$




$= 392.7$

## Maths Watch

| | |
|---|---|
| Volume | 115 & 119 |
| Surface Area | 114a, 114b |
| Sphere | 169 |
| Cones | 171 |
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