

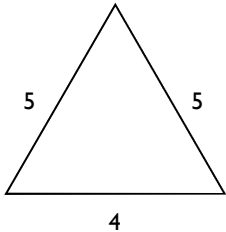
Perimeter, Area and Volume of Regular Shapes

Perimeter of Regular Polygons

Perimeter means the total length of all sides, or distance around the edge of a polygon.

For a polygon with straight sides this is the sum of all sides.

Eg. triangle



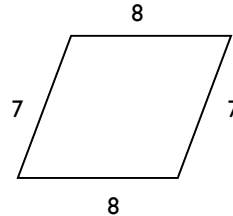
$$5 + 5 + 4 = 14\text{cm}$$

rectangle



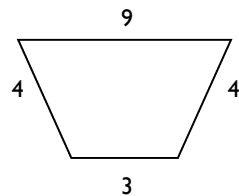
$$6 + 6 + 11 + 11 = 34\text{cm}$$

parallelogram



$$8 + 8 + 7 + 7 = 30\text{cm}$$

trapezium



$$4 + 4 + 9 + 3 = 20\text{cm}$$

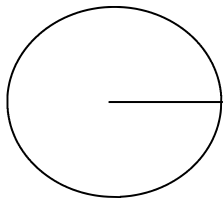
All dimensions given in cm (not drawn to scale)

For polygons with curved sides the perimeter is known as the circumference and is given by the formula

$$\text{Circumference} = 2\pi r \text{ for a circle} \quad \text{and} \quad 2\pi\sqrt{\frac{a^2 + b^2}{2}} \text{ for an ellipse}$$

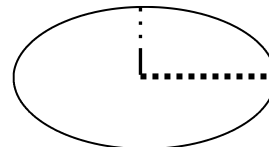
Where π is a mathematical constant with the value of 3.142 (correct to 3 decimal places)
 r is the radius of the circle (distance from centre to circumference)
 a is the major radius of an ellipse
 b is the minor radius of an ellipse

Eg.



radius = 5

$$\begin{aligned} \text{Circumference} &= 2\pi r \\ &= 2 \times 3.142 \times 5 \\ &= 31.42\text{cm} \end{aligned}$$



$a = 6\text{cm}$
 $b = 4\text{cm}$

$$\begin{aligned} \text{circumference} &= 2 \times 3.142 \sqrt{\frac{36 + 16}{2}} \\ &= 32.04\text{cm} \end{aligned}$$

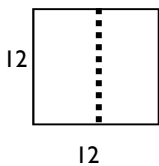
Area of Regular Polygons

The area of a polygon is the space it occupies in a single plane.

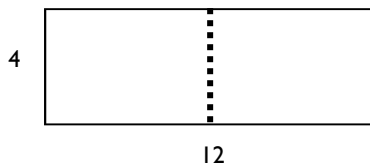
For squares, rectangles and parallelograms the area is given by

$$\text{Area} = \text{base} \times \text{height}$$

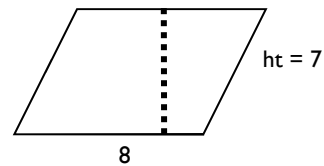
Eg.



$$12 \times 12 = 144\text{cm}^2$$



$$12 \times 4 = 48\text{cm}^2$$



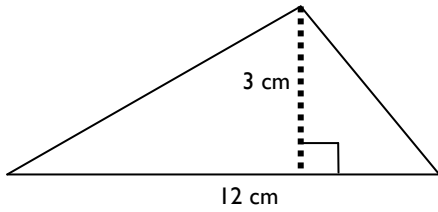
$$8 \times 7 = 56\text{cm}^2$$

Height is defined as the perpendicular distance between the pair of parallel sides

All dimensions given in cm (not drawn to scale)

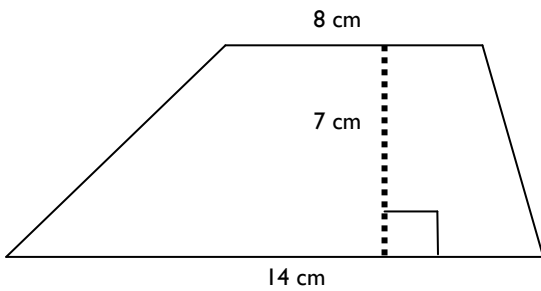
For Triangles area = $\frac{1}{2} \times \text{base} \times \text{height}$

Where height is distance from apex to meet base at right angle



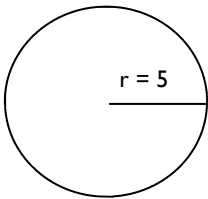
$$\text{Area} = \frac{1}{2} \times 12 \times 3 = 18\text{cm}^2$$

For Trapeziums area = $\frac{1}{2}$ sum of parallel sides \times height



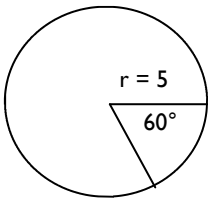
$$\text{Area} = \frac{1}{2} \times (8 + 14) \times 7 = 77\text{cm}^2$$

For Circles area = πr^2



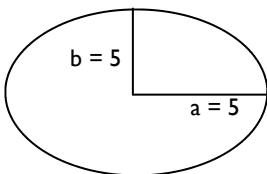
$$\begin{aligned} \text{Area} &= \pi r^2 \\ &= 3.142 \times 5^2 = 78.54\text{cm}^2 \end{aligned}$$

For a sector of a Circle area = area of circle $\times \frac{\text{sector angle}}{360}$



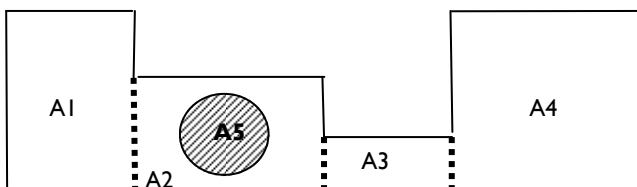
$$\text{Area of sector} = \pi r^2 \times \frac{60}{360} = 13.1\text{cm}^2$$

For Ellipse area = πab



$$\text{Area} = 3.142 \times 10 \times 5 = 157\text{cm}^2$$

Complex shapes for which there are no formulas should be divided into simple shapes. The area of each is then calculated and added together to determine the overall area.



$$\text{Area} = A1 + A2 + A3 + A4 - A5$$

Volume of Regular Shapes

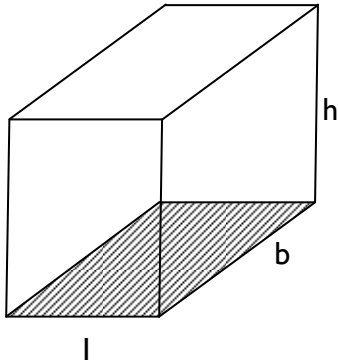
Volume is the amount of space in 3 dimensions occupied by a shape.

Prism

A prism is any shape where the cross-sectional area is constant.

For any prism: Volume = area of base x height

Rectangular Prism



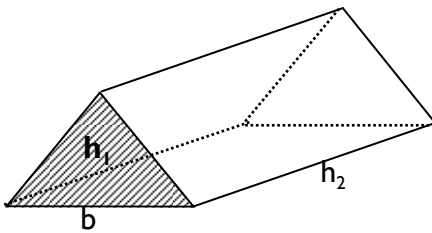
$$\begin{aligned} \text{area of base} &= \text{length} \times \text{breadth} \\ \text{volume} &= \text{length} \times \text{breadth} \times \text{height} \end{aligned}$$

eg. calculate the volume of a block with a square base of side 6cm and a height of 10cm

$$\text{volume} = l \times b \times h = 6 \times 6 \times 10 = 360\text{cm}^3$$

Shaded area is the base

Triangular Prism



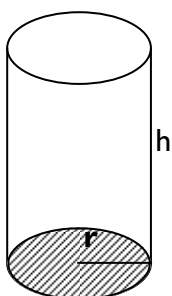
$$\text{area of base} = \frac{1}{2} \times \text{base} \times \text{height}$$

$$\text{volume} = \frac{1}{2} \times \text{base} \times h_1 \times h_2$$

eg. determine the volume of a component 16cm long with a triangular cross-section which has a base of 4cm and perpendicular height of 5cm

$$\begin{aligned} \text{area of base} &= \frac{1}{2} \times 4 \times 5 \\ \text{volume} &= \frac{1}{2} \times 4 \times 5 \times 16 \\ &= 160\text{cm}^3 \end{aligned}$$

Circular Prism



$$\begin{aligned} \text{area of base} &= \pi r^2 \\ \text{volume} &= \pi r^2 \times \text{height} \end{aligned}$$

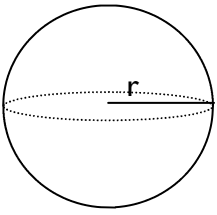
eg. calculate the volume of a cylinder with a radius of 5cm and a height of 4cm.

$$\begin{aligned} \text{volume} &= \pi r^2 \times \text{height} \\ &= 3.142 \times 5^2 \times 4 = 314.2\text{cm}^3 \end{aligned}$$

Shaded area is the base

The volume of certain non-prismatic shapes can be determined by using the correct formula.

Sphere

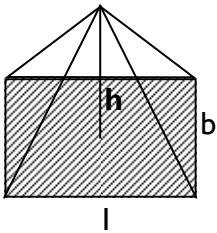


volume of a sphere = $\frac{4}{3} \pi r^3$

eg. determine the volume of a spherical component with the radius of 7cm.

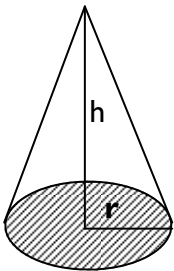
volume = $\frac{4 \times 3.142 \times 7^3}{3} = 1436.76\text{cm}^3$

Pyramid and cone



volume = $\frac{1}{3} \times \text{base area} \times \text{height}$

Pyramid volume = $\frac{1}{3} \times l \times b \times h$



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

eg. calculate the volume of a cone with base radius of 6cm and perpendicular height of 10cm

Volume = $\frac{1}{3} \times 3.142 \times 6^2 \times 10 = 376.00\text{cm}^3$

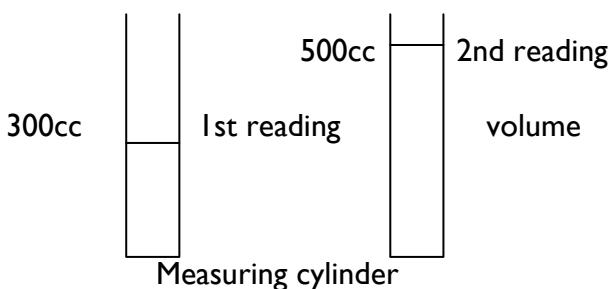
Volumes of irregular shapes can be determined by calculation if the mass and density of the material from which it is known or by displacement.

Calculation of volume using density and mass.

eg. density of substance from which an irregular object is made is 8500kg/m³. if it has a mass of 425kg, calculate its volume.

Volume = $\frac{\text{mass}}{\text{density}} = \frac{425}{8500} = 0.05\text{m}^3$

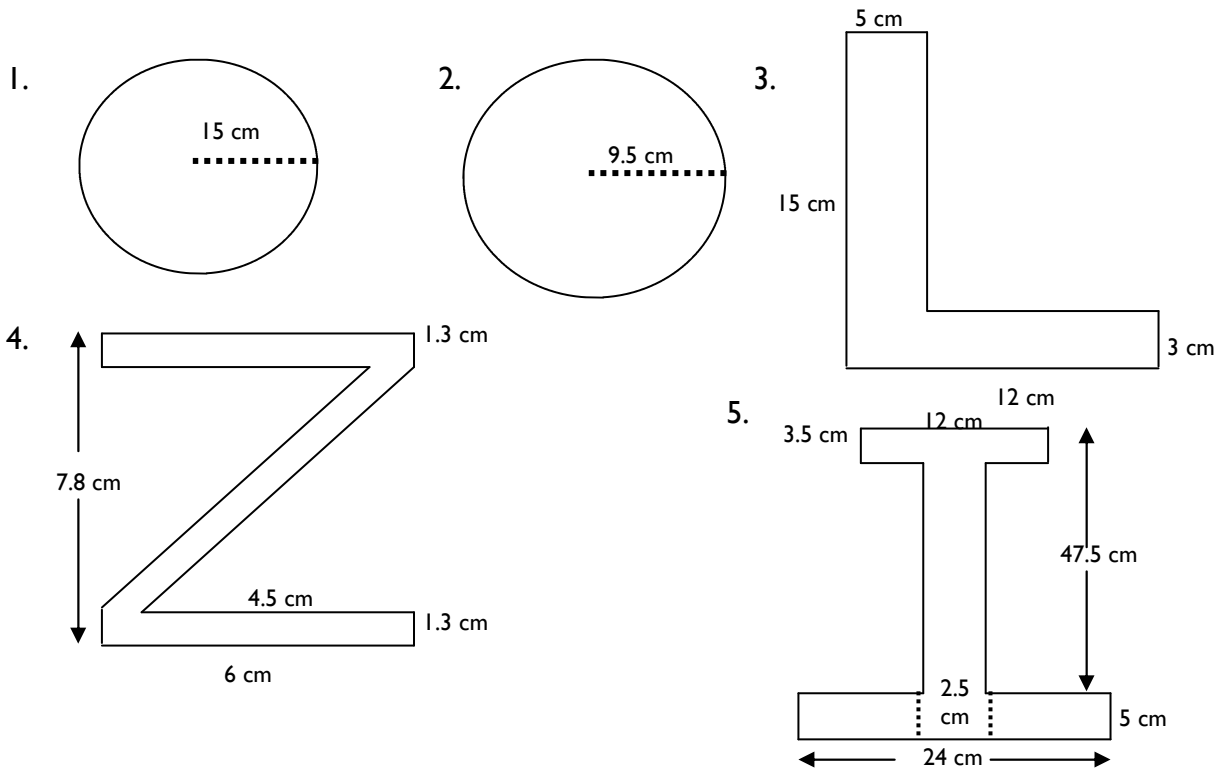
Measurement of volume using displacement



volume = 2nd reading – 1st reading
 = 500 – 300 = 200cc

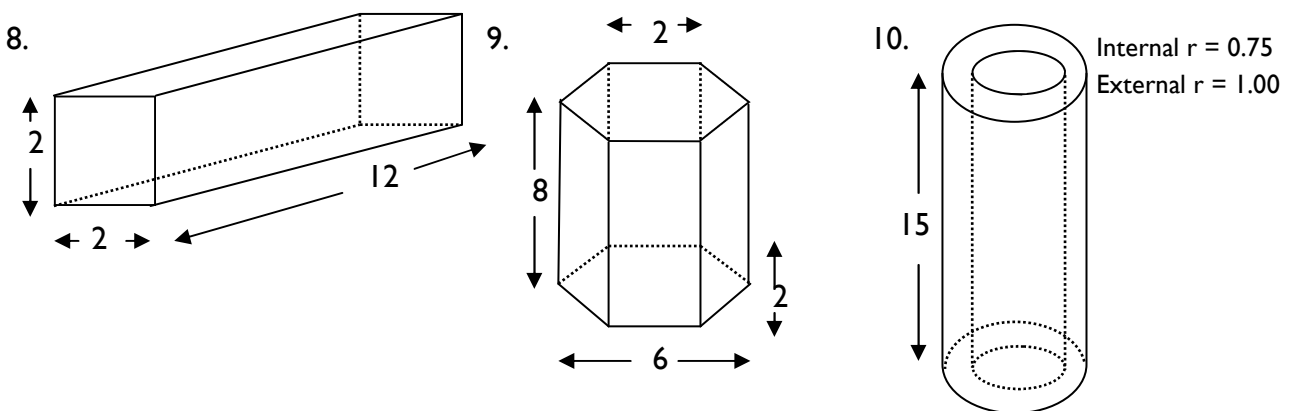
Perimeter, Area and Volume of Regular Shapes Worksheet I

Calculate the area of the following shapes



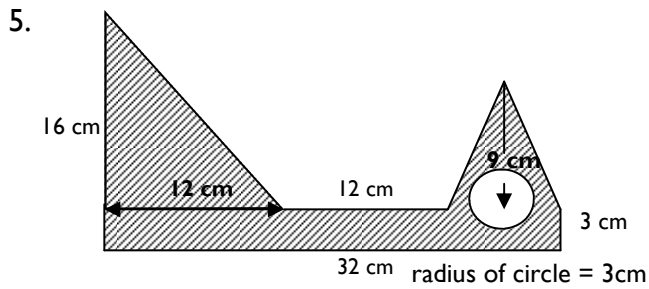
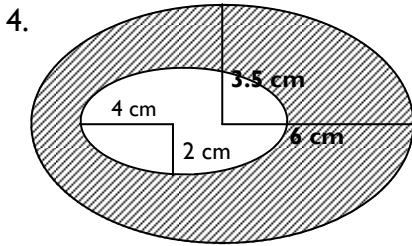
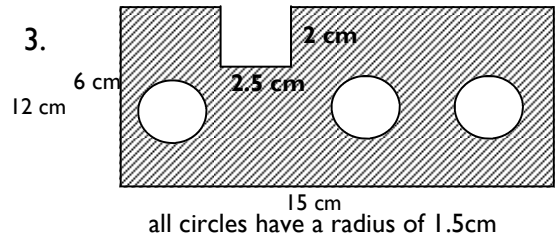
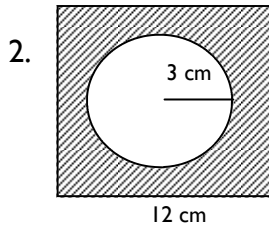
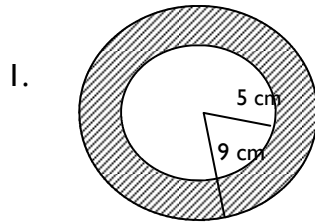
6. A water tank is a cuboid with a base of 1.2m by 0.8m. How deep is the water when the tank contains 0.384m^3 of water?
7. A classroom is $5\text{m} \times 6\text{m} \times 3\text{m}$. Health regulations require that each student must have a minimum of 5m^3 of air. How many students can occupy the room?

Calculate the volume of the following shapes. All dimensions in cm.



Perimeter, Area and Volume of Regular Shapes Worksheet 2

Calculate the shaded area of the following shapes



6. An ingot $80 \times 10 \times 300\text{mm}$ is cast into a cylinder 120mm diameter. Calculate its length.
7. A rivet has a hemispherical head 6mm radius and a stem of 6mm diameter and 15mm length. Calculate the volume of 100 of the rivets.
8. What would be the volume of (a) air (b) plastic in a ball with 25cm diameter made from plastic 2mm thick?

Calculate the volume of the following shapes. All dimensions in cm.

