

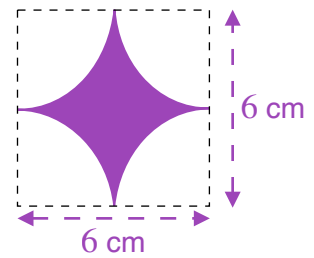
Volume and surface area of prisms and units of area/volume

Starter

1. (Review of last lesson)

Calculate the shaded area, giving your answer in terms of π .

Working: Area of square = $6^2 = 36 \text{ cm}^2$.
 The 4 quarter circles make up a whole circle
 of radius 3 cm and whose area is $\pi \times 3^2 = 9\pi$
 Shaded area = $36 - 9\pi$



2. (Review of previous material)

Convert: (a) 5 m^2 to cm^2 (b) 80000 mm^3 to cm^3 .

Working: (a) A rectangle of area 5 m^2 could have dimensions 5 m by 1 m
 $5 \text{ m}^2 = 5 \text{ m} \times 1 \text{ m}$
 $= 500 \text{ cm} \times 100 \text{ cm}$
 $= 50000 \text{ cm}^2$

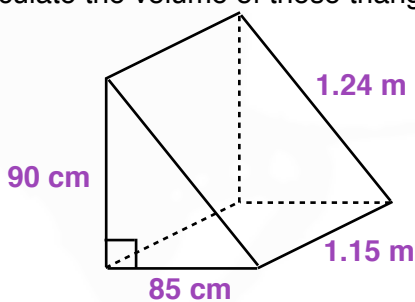
Alternatively: m to cm is $\times 100$
 Area so squared: m^2 to cm^2 is $\times 100^2$
 $5 \text{ m}^2 = 5 \times 100^2 = 5 \times 10000 = 50000 \text{ cm}^2$

(b) A cuboid of volume 80000 mm^3 could have dimensions 80 mm by 10 mm by 100 mm
 $80000 \text{ mm}^3 = 80 \text{ mm} \times 10 \text{ mm} \times 100 \text{ mm}$
 $= 8 \text{ cm} \times 1 \text{ cm} \times 10 \text{ cm}$
 $= 80 \text{ cm}^3$

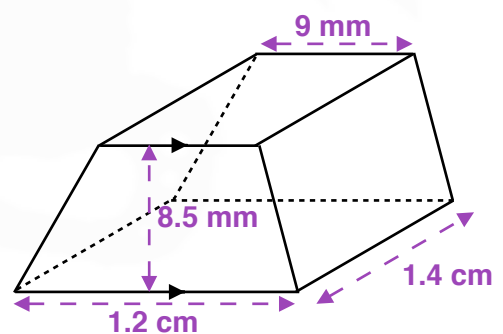
Alternatively: mm to cm is $\div 10$
 Volume so cubed: mm^3 to cm^3 is $\div 10^3$
 $80000 \text{ mm}^3 = 80000 \div 10^3 = 80000 \div 1000 = 80 \text{ cm}^3$

E.g. 1 Calculate the volume of these triangular prisms.

(a)



(b)



Working: (a) **Change all the lengths into metres:**

$$\text{Volume of prism} = \frac{1}{2} \times 0.85 \times 0.9 \times 1.15 = 0.439875 \text{ m}^3.$$

...or...

Change all the lengths into centimetres:

$$\text{Volume of prism} = \frac{1}{2} \times 85 \times 90 \times 115 = 439875 \text{ cm}^3.$$

- (b) The cross-section is a trapezium: Area of trapezium = $\frac{1}{2}(a + b)h$

Change all the lengths into centimetres:

$$\text{Volume of prism} = \frac{1}{2}(1.2 + 0.9) \times 0.85 \times 1.4 = 1.2495 \text{ cm}^3.$$

...or...

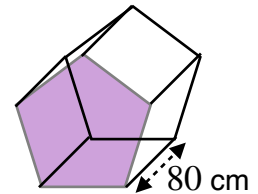
Change all the lengths into millimetres:

$$\text{Volume of prism} = \frac{1}{2}(12 + 9) \times 8.5 \times 14 = 1249.5 \text{ mm}^3.$$

- E.g. 2** The volume of the pentagonal prism is 3 m³.
Calculate the area of the pentagon that forms the cross-section.

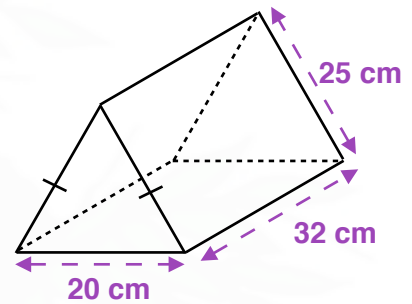
Working: Change the length to be in metres: 80 cm \equiv 0.8 m
Volume of prism = area of cross section \times length
 $3 = \text{Area} \times 0.8$
 $\text{Area} = \frac{3}{0.8} = 3.75$

The area of the pentagonal cross-section is 3.75 m².



Questions can bring in other areas of mathematics.

- E.g. 3** Calculate the volume of the triangular prism.
Give your answer to the nearest integer.



Working: To calculate the area of the triangular cross-section, we first need to calculate its perpendicular height, h , using Pythagoras:

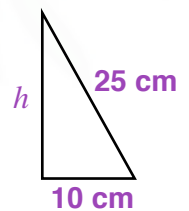
$$h^2 + 10^2 = 25^2$$

$$h^2 + 100 = 625$$

$$h^2 = 525$$

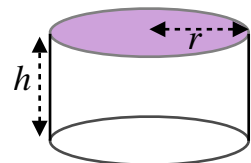
$$h = 5\sqrt{21} \approx 22.9 \text{ (keep this value on the calculator)}$$

$$\text{Volume of prism} = \frac{1}{2} \times 20 \times 5\sqrt{21} \times 32 = 7332 \text{ cm}^3.$$



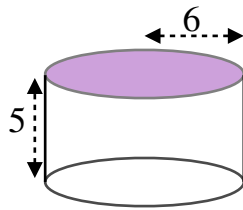
- E.g. 4** Using the formula for the prism, write down the formula for the volume of a cylinder whose radius is r and whose height is h .

Working: Area of cross-section = πr^2
So $V = \pi r^2 h$

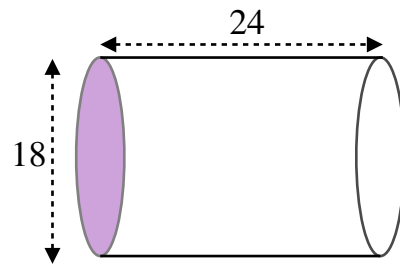


E.g. 5 Calculate the volume of these cylinders, giving your answers in terms of π .
All measurements in centimetres.

(a)



(b)



Working:

(a) $r = 6, h = 5$

Volume, $V = \pi r^2 h$:

$$V = \pi \times 6^2 \times 5 = 180\pi$$

(b) Halve the diameter to get the radius:

$r = 9, h = 24$

Volume, $V = \pi r^2 h$:

$$V = \pi \times 9^2 \times 24 = 1944\pi$$

E.g. 6 Find the height of a cylinder of volume 300 cm^3 and radius 7 cm . Give your answer to 3 s.f..

Working:

$V = 300, r = 7$

Volume, $V = \pi r^2 h$:

$$300 = \pi \times 7^2 \times h$$

$$300 = 49\pi h$$

$$\frac{300}{49\pi} = h$$

$$h \approx 1.9488$$

The height of the cylinder is 1.95 cm (3 s.f.)

E.g. 7 Find the radius of a cylinder of volume 185 cm^3 and length 5.3 cm .

Working:

$V = 185, h = 5.3$

Volume, $V = \pi r^2 h$:

$$185 = \pi \times r^2 \times 5.3$$

$$185 = 5.3\pi r^2$$

$$\frac{185}{5.3\pi} = r^2$$

$$r = \sqrt{\frac{185}{5.3\pi}}$$

$$r \approx 3.33$$

The radius of the cylinder is 3.33 cm (3 s.f.)

Video: [Volume of a prism](#)

Video: [Volume of a cylinder](#)

Video: [Surface area of a cuboid](#)

Video: [Surface area of prisms](#)

Video: [Surface area of a cylinder](#)

[Solutions to Starter and E.g.s](#)

Exercise

9-1 class textbook:

p437 M13.5 Qu 1-16

A*-G class textbook:

p392 M13.2 Qu 1-12

9-1 homework book:

p149 M13.5/13.6 Qu 1-6

A*-G homework book:

p110 M13.2 Qu 1-5