VOLUME OF A CYLINDER

BUILDING BLOCKS

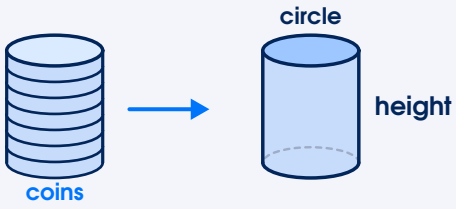
NAME _____ CLASS _____ DATE _____

KEY IDEA

A cylinder is like a stack of identical circles, just like a pile of coins.

Volume = area of the circle × height

Volume is measured in cubic units, such as cm^3.



1 Write the radius (r) and the height (h) of each cylinder.

When a cylinder lies on its side, its length is the height.

a) 3 cm, 8 cm

r = ☐ cm h = ☐ cm

b) 10 cm, 4 cm

r = ☐ cm h = ☐ cm

c) 2 cm, 9 cm

r = ☐ cm h = ☐ cm

2 Work out the area of each circle. $A = \pi \times r^2$. Use the π button. Round to 1 d.p.

a) 3 cm

$A = \pi \times 3^2 = \pi \times$ ☐ = ☐ cm^2

b) 6 cm

$A = \pi \times 6^2 = \pi \times$ ☐ = ☐ cm^2

3 The area of the base of each cylinder is given. Work out the volume (base area × height).

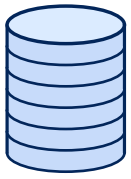
a) 5 cm, base area 12 cm^2

Volume = ☐ × ☐ = ☐ cm^3

b) 7 cm, base area 20 cm^2

Volume = ☐ × ☐ = ☐ cm^3

4 This is a stack of identical counters. Each counter has a volume of 3 cm^3.



a) How many counters are in this stack? ☐

b) What is the volume of the stack? ☐ cm^3

c) What is the volume of a stack of 20 counters? ☐ cm^3

VOLUME OF A CYLINDER

SUPPORT

NAME _____ CLASS _____ DATE _____

KEY IDEA

Volume of a cylinder: $V = \pi \times r^2 \times h$

Square the radius first, then multiply by π and by the height.
Keep the full number on your calculator. Round at the end.

Example: r = 2 cm, h = 5 cm $V = \pi \times 2^2 \times 5 = \pi \times 4 \times 5 = 62.8$ cm³

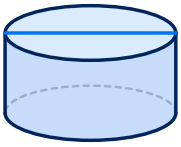
1 Work out the volume of this cylinder. Round your answer to 1 d.p.



$V = \pi \times 6^2 \times 5 = \pi \times __ \times 5 = __$ cm³

2 The diameter of this cylinder is 15 cm. Halve it first to find the radius. Round to 1 d.p.

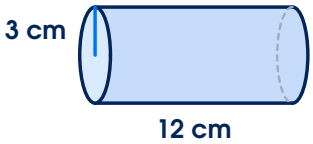
Radius = 15 ÷ 2 = _____ cm



$V = \pi \times __^2 \times 3 = \pi \times __ \times 3 = __$ cm³

radius

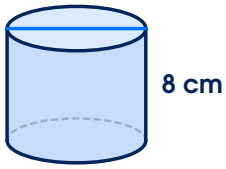
3 This cylinder is lying on its side. Its length is the height. Work out its volume (1 d.p.).



Area of the circle = π × _____ ² = _____ cm²

Volume = _____ × _____ = _____ cm³

4 This cylinder has diameter 10 cm and height 8 cm.



a) Tick the calculation for the volume of this cylinder.

☐ $\pi \times 10^2 \times 8$ ☐ $\pi \times 5^2 \times 8$ ☐ $\pi \times 5 \times 8$ ☐ $2 \times \pi \times 5 \times 8$

b) Work out the volume. Round to 1 d.p. _____ cm³

VOLUME OF A CYLINDER

CORE

NAME _____ CLASS _____ DATE _____

KEY IDEA

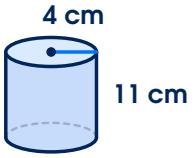
$V = \pi \times r^2 \times h$ (area of the circular cross-section × height or length)

Square the radius, not the diameter. Volume is in cubic units: cm^3, m^3.

FLUENCY

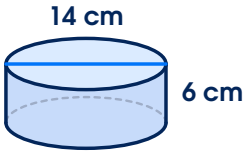
1 Work out the volume of each cylinder. Round to 1 d.p.

a)



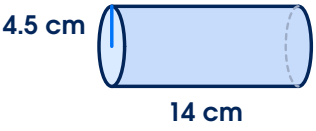
_____ cm^3

b)



_____ cm^3

c)



_____ cm^3

2 Give each answer in terms of π.

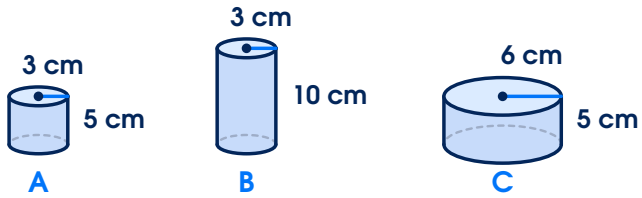
a) radius 3 cm, height 11 cm _____ π cm^3

b) diameter 10 cm, height 7 cm _____ π cm^3

c) radius 6 cm, volume 252π cm^3 _____ cm ← find the height

REASONING

3 Work out the volume of each cylinder in cm^3. Give each answer in terms of π.



a) Volume of A _____ π

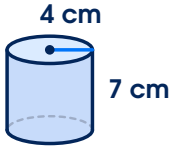
b) Volume of B _____ π

c) Volume of C _____ π

d) What happens to the volume when the height doubles? When the radius doubles?

.....

4 Sam works out the volume of this cylinder. He is wrong. Round to 1 d.p.



Sam's working

$V = \pi \times 4 \times 7 = 88.0\ cm^3$

a) Explain Sam's mistake.

.....

b) Correct volume _____ cm^3

VOLUME OF A CYLINDER

GREATER DEPTH

NAME _____ CLASS _____ DATE _____

REASONING

1 Is each statement always, sometimes or never true? Circle your answer.

Give an example or a reason for each answer.

a) Doubling the radius doubles the volume. ALWAYS SOMETIMES NEVER

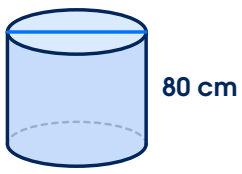
b) Halving the height halves the volume. ALWAYS SOMETIMES NEVER

c) Cylinders with equal volumes have equal radii. ALWAYS SOMETIMES NEVER

d) If r = h, the volume is πr^3. ALWAYS SOMETIMES NEVER

PROBLEM SOLVING

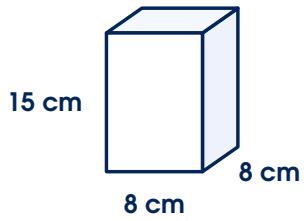
2 A water tank is a cylinder with diameter 50 cm and height 80 cm. 1 litre = 1000 cm^3.



a) Work out its capacity in litres (1 d.p.). _____ litres

b) Water flows in at 4 litres per minute. Will the empty tank be full within 40 minutes? Show how you know.

3 A tin fits exactly inside this cuboid box. It touches every face of the box.



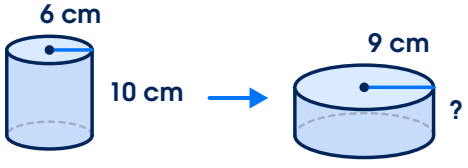


Work out the volume of the space around the tin. Round to 1 d.p.

_____ cm^3

★ CHALLENGE FOR ALL

4 A full cylinder of water, radius 6 cm and height 10 cm, is poured into an empty cylinder of radius 9 cm.



a) How deep is the water? (1 d.p.) _____ cm

b) Another cylinder has height = radius and a volume of 1000 cm^3. Find r (1 d.p.). _____

VOLUME OF A CYLINDER – ANSWERS

ANSWERS

BUILDING BLOCKS

1 a) radius 3 cm, height 8 cm b) radius 5 cm, height 4 cm c) radius 2 cm, height 9 cm
2 a) $\pi \times 3^2 = \pi \times 9 = 28.3\ cm^2$ b) $\pi \times 6^2 = \pi \times 36 = 113.1\ cm^2$
3 a) $12 \times 5 = 60\ cm^3$ b) $20 \times 7 = 140\ cm^3$
4 a) 6 b) $6 \times 3 = 18\ cm^3$ c) $20 \times 3 = 60\ cm^3$

SUPPORT

1 $\pi \times 6^2 \times 5 = \pi \times 36 \times 5 = 565.5\ cm^3$
2 radius 7.5 cm · $\pi \times 7.5^2 \times 3 = \pi \times 56.25 \times 3 = 530.1\ cm^3$
3 $\pi \times 3^2 = 28.3\ cm^2$ · $28.3 \times 12 = 339.3\ cm^3$ (339.6 if the rounded area is used)
4 a) $\pi \times 5^2 \times 8$ b) $628.3\ cm^3$

CORE

1 a) $176\pi = 552.9\ cm^3$ b) $294\pi = 923.6\ cm^3$ c) $283.5\pi = 890.6\ cm^3$
2 a) $99\pi\ cm^3$ b) $175\pi\ cm^3$ c) $252\pi \div 36\pi = 7$ cm
3 a) 45π b) 90π c) 180π d) height doubles → volume doubles (h is multiplied once); radius doubles → volume × 4 (r is squared: $2^2 = 4$)
4 a) He did not square the radius ($\pi \times 4 \times 7$ instead of $\pi \times 4^2 \times 7$). b) $112\pi = 351.9\ cm^3$

GREATER DEPTH

1 a) never (it multiplies the volume by 4) b) always ($V = \pi r^2 h$, so V halves) c) sometimes (e.g. r 2, h 9 and r 3, h 4 both 36π) d) always ($\pi r^2 \times r = \pi r^3$)
2 a) $\pi \times 25^2 \times 80 = 157\,079.6\ cm^3 = 157.1$ litres b) $157.1 \div 4 = 39.3$ minutes, so yes (just)
3 box $8 \times 8 \times 15 = 960\ cm^3$; tin $\pi \times 4^2 \times 15 = 754.0\ cm^3$; space $960 - 754.0 = 206.0\ cm^3$
4 a) $360\pi \div (\pi \times 9^2) = 360 \div 81 = 4.4$ cm b) $\pi r^3 = 1000$, $r^3 = 318.3...$, $r = 6.8$ cm