

Student Name

Mathematics Stage 4

VOLUME

Book 3 Develop the formula for finding the volume of a cylinder and apply the formula to solve problems

Version: 260207

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OVERVIEW

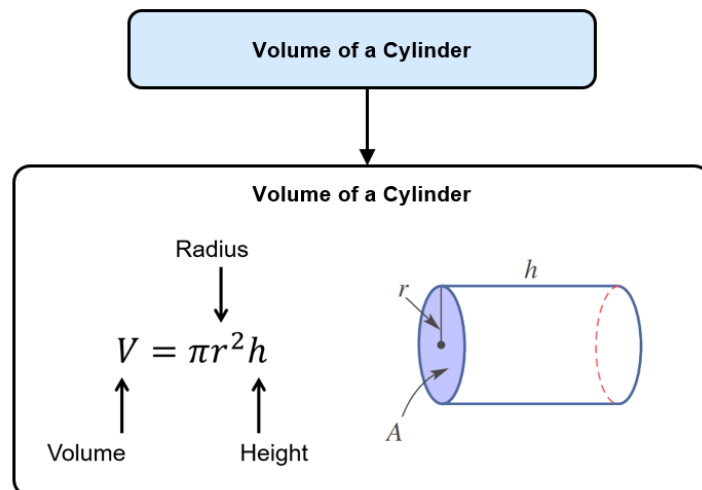
SYLLABUS CONTENT

MA4-VOL-C-01 applies knowledge of volume and capacity to solve problems involving right prisms and cylinders

Develop the formula for finding the volume of a cylinder and apply the formula to solve problems

- Develop and apply the formula to solve problems involving the volume of cylinders: $V = \pi r^2 h$, where r is the length of the radius of the base and h is the perpendicular height

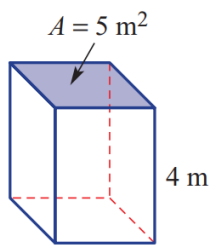
SUMMARY



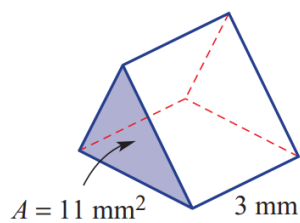
REVIEW OF PRIOR KNOWLEDGE

1 Calculate the volume of these prisms.

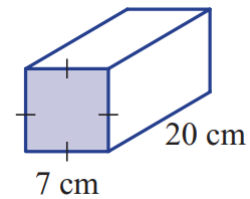
a



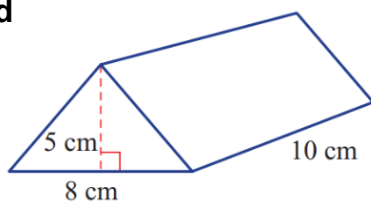
b



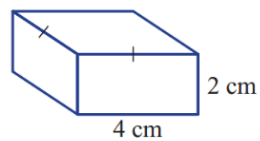
c



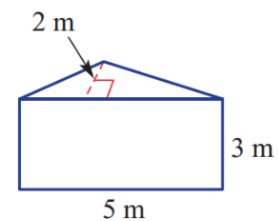
d



e



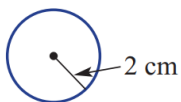
f



2 Calculate the area of these circles.

Give your answer in exact form and then rounded to two decimal places.

a

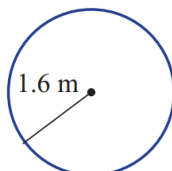


$$A = \pi r^2$$

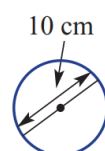
$$= 4\pi$$

$$= \dots\dots\dots$$

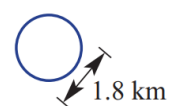
b



c

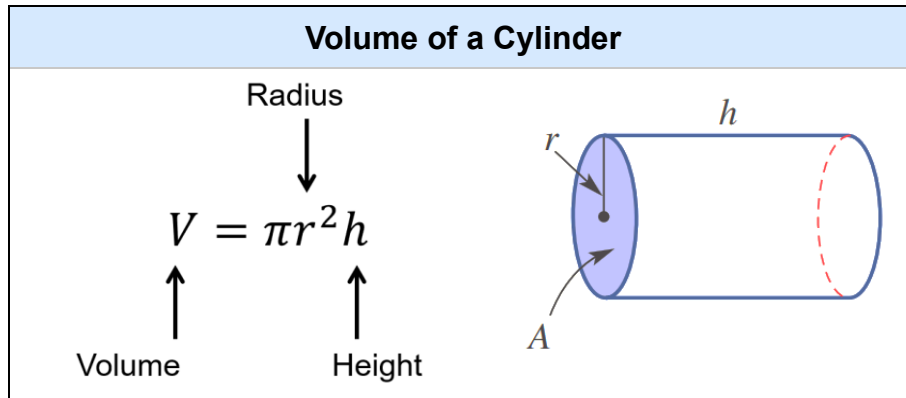


d



VOLUME OF A CYLINDER

- A **cylinder** is a 3D solid with uniform cross-section of a circle.
- The volume of a cylinder is calculated using $V = Ah$, where $A = \pi r^2$



Example Calculate volume of a cylinder.

Calculate the volume of these cylinders. Round your answer to 2 decimal places. $V = \pi r^2 h$ $= \pi \times 2^2 \times 10$ $= 125.66 \text{ cm}^3$	Why is the formula for a volume of a cylinder given by $V = \pi r^2 h$? <i>The area of a solid with uniform cross-section is $V = Ah$, in this case, $A = \dots\dots\dots$ as the base area is a circle.</i>
$V = \pi r^2 h$ $= \pi \times 7^2 \times 20$ $= 3078.76 \text{ m}^3$	Why is $r = 7$ in this example? <i>14 is the, the radius is of the diameter, so $r = 7$</i>

Calculate the volume of these cylinders. Round your answer to 2 decimal places.

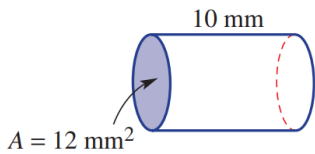
a $V = Ah$ $= \dots\dots\dots$ $= \dots\dots\dots$ 785.40 m³	b $V = Ah$ $= \dots\dots\dots$ $= \dots\dots\dots$ 461.81 m³
c 251.33 cm³	d 12566.37 mm³

Key ideas

- A cylinder is similar to a prism because it has
- The volume of any solid with uniform cross section is $V = \dots\dots\dots$
- The volume of a cylinder is $V = \pi r^2 h$ because the area of the base is

1 The area of the base is given. Calculate the volume of these cylinders.

a



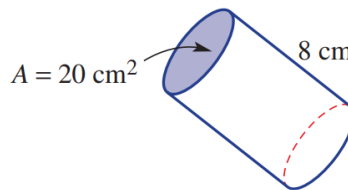
$$V = Ah$$

$$= \dots\dots\dots$$

$$= \dots\dots\dots$$

120 mm³

b



$$V = \dots\dots\dots$$

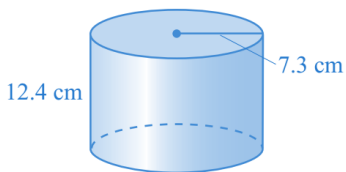
$$= \dots\dots\dots$$

$$= \dots\dots\dots$$

160 cm³

2 Complete to calculate the volume of the cylinder to the nearest cubic cm.

a



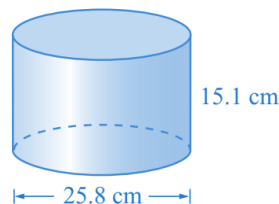
$$V = \pi r^2 h$$

$$= \pi \times \dots^2 \times \dots$$

$$= \dots\dots\dots \text{cm}^3$$

2076 cm³

b



$$V = \pi r^2 h$$

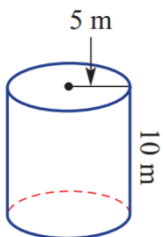
$$= \pi \times \dots^2 \times \dots$$

$$= \dots\dots\dots \text{cm}^3$$

7894 cm³

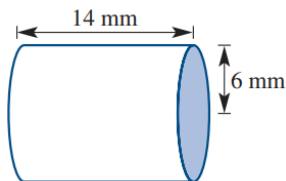
3 Calculate the volume of these cylinders. Give your answer in exact form in terms of π .

a



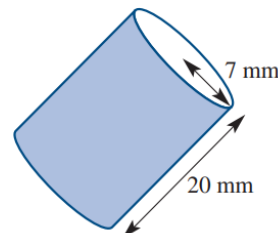
250π m³

b



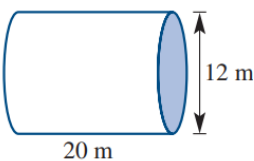
504π mm³

c



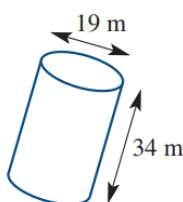
980π mm³

d



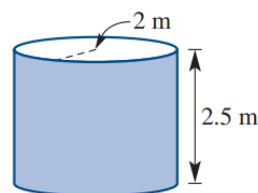
720π m³

e



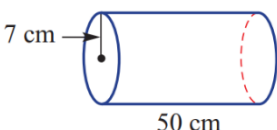
3068.5π m³

f



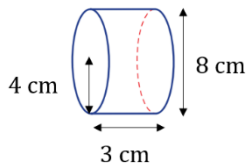
10π m³

g



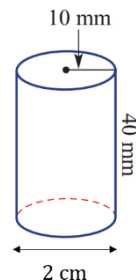
2450π cm³

h



48π cm³

i

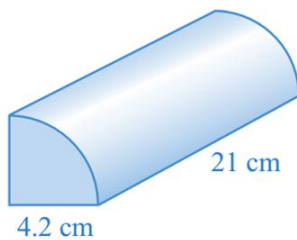


4000π mm³

- 4 A cylindrical tank has a diameter of 3 m and height 2 m.
Calculate the volume in cubic metres (m^3), answer to 1 d.p.

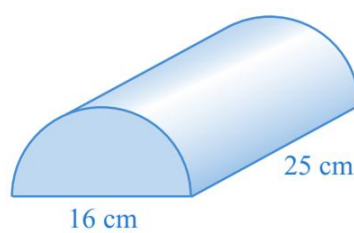
- 5 Calculate the volume of these fractions of a cylinder. Answer to 2 d.p.

a



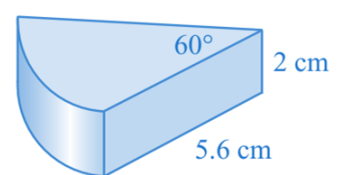
290.94 cm^3

b



2513.27 cm^3

c

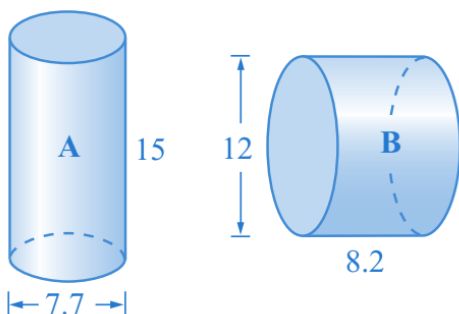


32.84 cm^3

14.1 cm^3

- 6 A cylindrical tin of beans has radius 4 cm and a height of 10 cm.
The can contains 400 cm^3 of beans. How much empty space is there inside the tin?

- 7 Determine which of these prisms has the largest volume.



102.65 cm^3

Cylinder A: 698.5

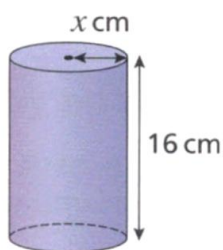
Cylinder B: 927.4

Cylinder B is larger.

- 8 Determine the unknown dimension of the cylinder.

a

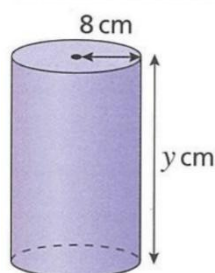
$$V = 615.8 \text{ cm}^3$$



$$x = 3.5 \text{ cm}$$

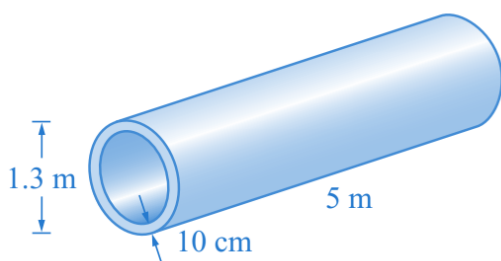
b

$$\text{Volume} = 2513 \text{ cm}^3$$



$$y = 12.5 \text{ cm}$$

- 9 Concrete sewer pipes are 5 m long with an outer diameter of 1.3 m. The walls of the pipes are 10 cm thick. What volume of concrete is required to make each pipe? Express your answer in m^3 correct to 2 decimal places.



$$\text{Large cylinder} - \text{small cylinder} = \pi(0.65)^2(5) - \pi(0.55)^2(5) = 1.88 \text{ m}^3$$

- 10 A cylindrical wheat hopper is 8 m in diameter and 10 m high.

a Calculate its volume correct to two decimal places.

$$V = \pi(4)^2(10) = 502.65 \text{ m}^3$$

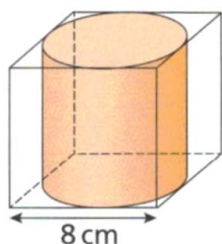
b Grain pours out at $48\,000 \text{ cm}^3$ per second. How long would it take a full hopper to empty? Answer correct to the nearest minute. $1\,000\,000 \text{ cm}^3 = 1 \text{ m}^3$

$$175 \text{ minutes.}$$

- 11 A cube has every single one of its sides doubled. How many times is the new volume compared to the original?

$$8 \text{ times}$$

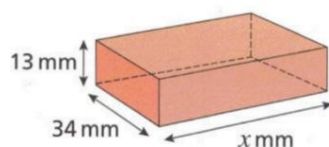
- 12 Express the volume of the cylinder as a percentage of the volume of the cube. Answer to 1 d.p.



$$\frac{V_{\text{Cyl}}}{V_{\text{cube}}} \times 100 = \frac{\pi(4)^2(8)}{8^3} \times 100 = 78.5\%$$

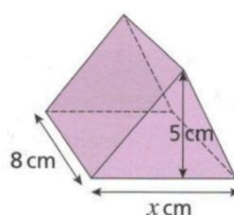
- 13 Find the missing length in each of these shapes.

a $V = 22\,100 \text{ mm}^3$



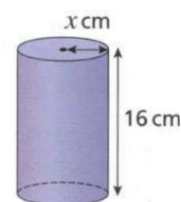
50 mm

b $V = 180 \text{ cm}^3$



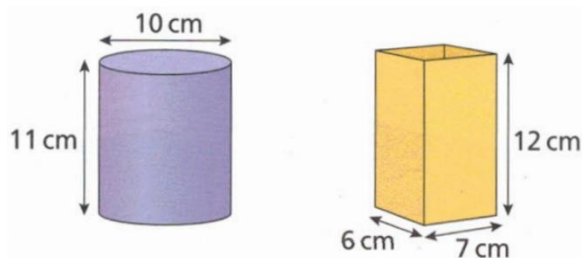
9 cm

c $V = 615.8 \text{ cm}^3$



3.5 cm

- 14 Marta fills the cylindrical container with water. She then pours the water into the rectangular prism-shaped container. Will all of the water fit into the rectangular prism? Justify your answer with mathematical reasoning.

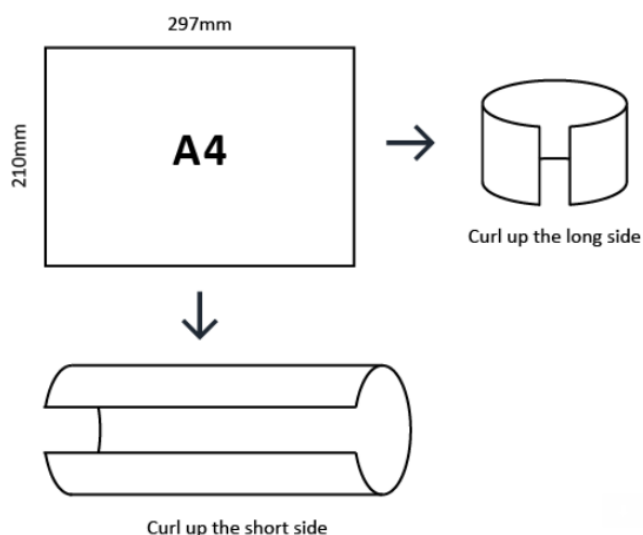


Volume of cylinder: 863.94 cm^3

Volume of rectangular prism: 504 cm^3

No, the volume of the prism is less than the cylinder.

- 15 Which cylinder would have a greater volume? Justify your answer with mathematical reasoning.



Short side: $C = 2\pi r = 210, r = \frac{210}{2\pi}$

$$V_{\text{curl short side}} = \pi \left(\frac{210}{2\pi} \right)^2 (297) \approx 1042282 \text{ cm}^3$$

Long side: $C = 2\pi r = 297, r = \frac{297}{2\pi}$

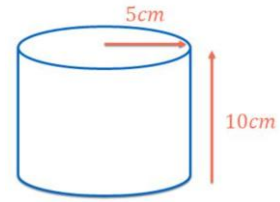
$$V_{\text{curl long side}} = \pi \left(\frac{297}{2\pi} \right)^2 (210) \approx 1474084 \text{ cm}^3$$

$\therefore$ cylinder curled up long side has larger volume.

CHECK YOUR UNDERSTANDING

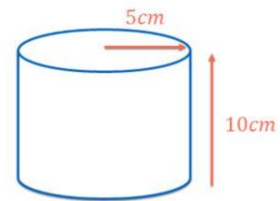
Volume of a cylinder

1 What is the area of the cross-section of the cylinder?



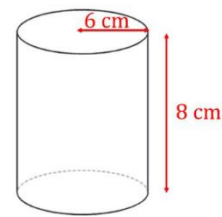
- a** $5\pi \text{ cm}^2$ **b** $10\pi \text{ cm}^2$ **c** $50\pi \text{ cm}^2$ **d** $25\pi \text{ cm}^2$

2 What is the volume of the cylinder?



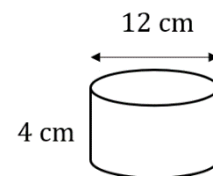
- a** $100\pi \text{ cm}^2$ **b** $250\pi \text{ cm}^2$ **c** $50\pi \text{ cm}^2$ **d** $25\pi \text{ cm}^2$

3 What is the volume of the cylinder?



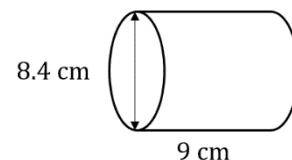
- a** $288\pi \text{ cm}^2$ **b** $96\pi \text{ cm}^2$ **c** $48\pi \text{ cm}^2$ **d** $14\pi \text{ cm}^2$

4 What is the volume of the cylinder, rounded to 2 d.p.?



- a** 150.79 cm^2 **b** 150.80 cm^2 **c** 452.38 cm^2 **d** 452.39 cm^2

5 What is the volume of the cylinder?



- a** 1994 cm^2 **b** 237.3 cm^2 **c** 498.5 cm^2 **d** 158.8 cm^2