

Cylinders: Surface Area & Volume

KEY IDEAS

Volume (space inside) = area of the circle $\times$ height: $V = \pi r^2 h$ (units: cm^3 , m^3)

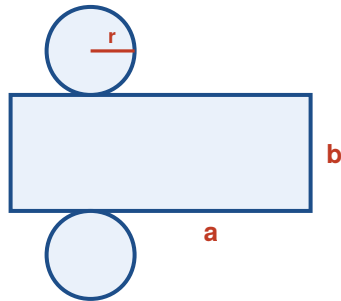
Surface area (outside covering) = two circular ends + the curved side: $SA = 2\pi r^2 + 2\pi rh$ (units: cm^2 , m^2)

The curved side unrolls into a rectangle that is **$2\pi r$ long** and **h tall**. If you're given the diameter, **halve it** first.

Use $\pi \approx 3.14$ and round answers to one decimal place.

A The net of a cylinder

2 marks



- Side **a** of the rectangle is the same length as the _____
- Side **b** of the rectangle is the same length as the _____

B Find the volume

4 marks

3. _____	4. _____	5. _____	6. _____
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C Find the surface area

6 marks (2 each)

Find the area of the two ends and the curved side, then add them.

7. _____	8. _____	9. _____
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D Work backwards

4 marks (2 each)

10. A cylinder has a volume of 1570 cm^3 and a radius of 5 cm. Find its height.

11. A cylinder has a volume of 301.44 m^3 and a height of 6 m. Find its radius.

E Open cylinders and labels

4 marks (2 each)

12. A cylindrical pencil cup has **no lid**. Its radius is 4 cm and its height is 10 cm. How much material is needed to make it?

13. A paper label wraps around the side of a can (not the top or bottom). The can is 7.5 cm across and 11 cm tall. What is the area of the label?

F Real-world problems

8 marks (2 each)

14. A water tank is a cylinder with radius 1.5 m and height 2 m. Find its volume. How many litres does it hold? ($1 \text{ m}^3 = 1000 \text{ L}$)

15. A juice can is 6.6 cm across and 12 cm tall. About how many millilitres of juice can it hold? ($1 \text{ cm}^3 = 1 \text{ mL}$)

16. Cylinder A has $r = 2 \text{ cm}$ and $h = 8 \text{ cm}$. Cylinder B has $r = 4 \text{ cm}$ and $h = 2 \text{ cm}$. Which holds more?

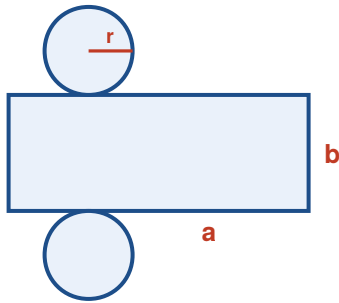
17. The curved side of a pillar (diameter 0.5 m, height 3 m) needs paint. One litre of paint covers 2 m^2 . How many 1-litre cans are needed?

G Spot the mistake

2 marks

18. For a cylinder with diameter 6 cm and height 5 cm, a student writes $V = 3.14 \times 6^2 \times 5 = 565.2 \text{ cm}^3$. Explain the error and correct it.

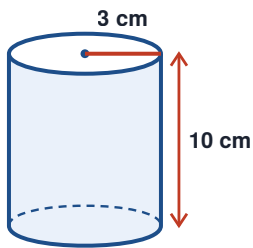
19. For a closed cylinder with $r = 2 \text{ cm}$ and $h = 5 \text{ cm}$, a student writes $SA = 3.14 \times 2^2 + 2 \times 3.14 \times 2 \times 5 = 75.36 \text{ cm}^2$. Explain the error and correct it.

Cylinders: Surface Area & Volume**ANSWER KEY****KEY IDEAS****Volume** (space inside) = area of the circle $\times$ height: $V = \pi r^2 h$ (units: cm^3 , m^3)**Surface area** (outside covering) = two circular ends + the curved side: $SA = 2\pi r^2 + 2\pi rh$ (units: cm^2 , m^2)The curved side unrolls into a rectangle that is **$2\pi r$ long** and **h tall**. If you're given the diameter, **halve it** first.Use $\pi \approx 3.14$ and round answers to one decimal place.**A The net of a cylinder****2 marks**

- Side **a** of the rectangle is the same length as the **circumference ($2\pi r$)**
- Side **b** of the rectangle is the same length as the **height (h)**

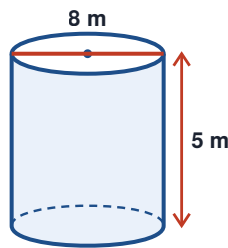
B Find the volume**4 marks**

3.



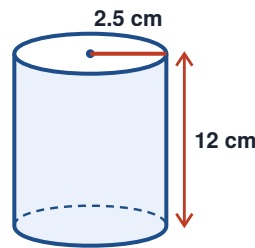
$$V = 3.14 \times 3^2 \times 10 = 282.6 \text{ cm}^3$$

4.



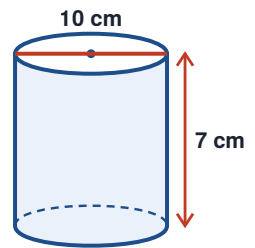
$$r = 8 \div 2 = 4. \quad V = 3.14 \times 4^2 \times 5 = 251.2 \text{ m}^3$$

5.



$$V = 3.14 \times 2.5^2 \times 12 = 235.5 \text{ cm}^3$$

6.

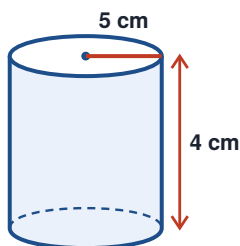


$$r = 10 \div 2 = 5. \quad V = 3.14 \times 5^2 \times 7 = 549.5 \text{ cm}^3$$

C Find the surface area**6 marks (2 each)**

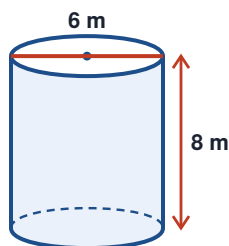
Find the area of the two ends and the curved side, then add them.

7.



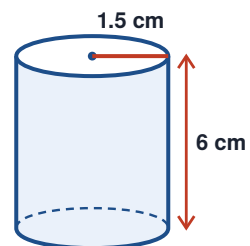
$$\begin{aligned} \text{Ends: } 2 \times 3.14 \times 5^2 &= 157 \\ \text{Side: } 2 \times 3.14 \times 5 \times 4 &= 125.6 \\ \text{SA} &= 282.6 \text{ cm}^2 \end{aligned}$$

8.



$$\begin{aligned} r = 3. \quad \text{Ends: } 2 \times 3.14 \times 3^2 &= 56.52 \\ \text{Side: } 2 \times 3.14 \times 3 \times 8 &= 150.72 \\ \text{SA} &= 207.24 \approx 207.2 \text{ m}^2 \end{aligned}$$

9.



$$\begin{aligned} \text{Ends: } 2 \times 3.14 \times 1.5^2 &= 14.13 \\ \text{Side: } 2 \times 3.14 \times 1.5 \times 6 &= 56.52 \\ \text{SA} &= 70.65 \approx 70.7 \text{ cm}^2 \end{aligned}$$

D Work backwards

4 marks (2 each)

10. A cylinder has a volume of 1570 cm^3 and a radius of 5 cm. Find its height.

$$1570 = 3.14 \times 5^2 \times h = 78.5h, \text{ so } h = 1570 \div 78.5 = \mathbf{20 \text{ cm}}$$

11. A cylinder has a volume of 301.44 m^3 and a height of 6 m. Find its radius.

$$301.44 = 3.14 \times r^2 \times 6 = 18.84r^2, \text{ so } r^2 = 16 \text{ and } r = \mathbf{4 \text{ m}}$$

E Open cylinders and labels

4 marks (2 each)

12. A cylindrical pencil cup has **no lid**. Its radius is 4 cm and its height is 10 cm. How much material is needed to make it?

$$\text{One end: } 3.14 \times 4^2 = 50.24. \text{ Side: } 2 \times 3.14 \times 4 \times 10 = 251.2. \text{ Total} = 301.44 \approx \mathbf{301.4 \text{ cm}^2}$$

13. A paper label wraps around the side of a can (not the top or bottom). The can is 7.5 cm across and 11 cm tall. What is the area of the label?

$$\text{Side only: } \pi dh = 3.14 \times 7.5 \times 11 = 259.05 \approx \mathbf{259.1 \text{ cm}^2}$$

F Real-world problems

8 marks (2 each)

14. A water tank is a cylinder with radius 1.5 m and height 2 m. Find its volume. How many litres does it hold? ($1 \text{ m}^3 = 1000 \text{ L}$)

$$V = 3.14 \times 1.5^2 \times 2 = \mathbf{14.13 \text{ m}^3 = 14 \text{ 130 L}}$$

15. A juice can is 6.6 cm across and 12 cm tall. About how many millilitres of juice can it hold? ($1 \text{ cm}^3 = 1 \text{ mL}$)

$$r = 3.3. V = 3.14 \times 3.3^2 \times 12 = 410.3352 \approx \mathbf{410.3 \text{ cm}^3 \approx 410 \text{ mL}}$$

16. Cylinder A has $r = 2 \text{ cm}$ and $h = 8 \text{ cm}$. Cylinder B has $r = 4 \text{ cm}$ and $h = 2 \text{ cm}$. Which holds more?

$$\text{A: } 3.14 \times 2^2 \times 8 = 100.48 \text{ cm}^3. \text{ B: } 3.14 \times 4^2 \times 2 = 100.48 \text{ cm}^3. \text{ They hold the same amount.}$$

17. The curved side of a pillar (diameter 0.5 m, height 3 m) needs paint. One litre of paint covers 2 m^2 . How many 1-litre cans are needed?

$$\text{Side} = \pi dh = 3.14 \times 0.5 \times 3 = 4.71 \text{ m}^2. 4.71 \div 2 = 2.355 \text{ L, so buy } \mathbf{3 \text{ cans}}$$

G Spot the mistake

2 marks

18. For a cylinder with diameter 6 cm and height 5 cm, a student writes $V = 3.14 \times 6^2 \times 5 = 565.2 \text{ cm}^3$. Explain the error and correct it.

$$\text{The formula uses the } \mathbf{radius}, \text{ which is 3. } V = 3.14 \times 3^2 \times 5 = \mathbf{141.3 \text{ cm}^3}.$$

19. For a closed cylinder with $r = 2 \text{ cm}$ and $h = 5 \text{ cm}$, a student writes $SA = 3.14 \times 2^2 + 2 \times 3.14 \times 2 \times 5 = 75.36 \text{ cm}^2$. Explain the error and correct it.

$$\text{A closed cylinder has } \mathbf{two} \text{ circular ends: } 2 \times 3.14 \times 2^2 = 25.12. SA = 25.12 + 62.8 = 87.92 \approx \mathbf{87.9 \text{ cm}^2}.$$