

Cylinders

Solutions

For Pearson Edexcel GCSE Mathematics (1MA1) • Foundation tier

Each question is shown in grey, followed by the working, one step per line. The final answer is in a box. *Marks* shows how the marks are usually given in the exam, and **Tip** points out a common mistake.

1 (2 marks)

Here is a solid cylinder.

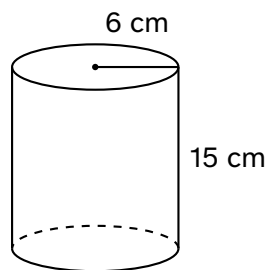


Diagram **NOT** accurately drawn

Work out the volume of the cylinder.

Give your answer correct to 1 decimal place.

$$\text{Volume of a cylinder} = \pi r^2 h$$

Here $r = 6$ and $h = 15$.

$$V = \pi \times 6^2 \times 15$$

$$= 1696.46 \dots$$

Round to 1 decimal place: 1696.5

Answer: 1696.5 cm³

Tip: Square the radius, not the height. $\pi \times 6 \times 15$ (radius $\times$ height) is a very common wrong method.

Marks: 1 mark for $\pi \times 6^2 \times 15$. 1 mark for 1696.5.

2 (2 marks)

Here is a cylinder.

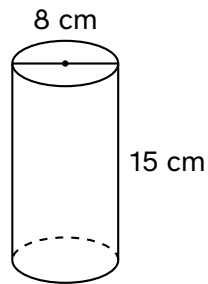


Diagram **NOT** accurately drawn

The cylinder has diameter 8 cm and height 15 cm.

Work out the volume of the cylinder.

Give your answer in terms of π .

The diameter is 8 cm, so the radius is $r = 8 \div 2 = 4$ cm.

$$\text{Volume} = \pi r^2 h$$

$$= \pi \times 4^2 \times 15$$

$$= \pi \times 16 \times 15 = 240\pi$$

Answer: $240\pi \text{ cm}^3$

Tip: Halve the diameter to get the radius first. Using 8 as the radius gives 960π , which is 4 times too big.

Marks: 1 mark for $\pi \times 4^2 \times 15$. 1 mark for 240π .

3 (3 marks)

A closed cylindrical can has diameter 6 cm and height 9 cm.

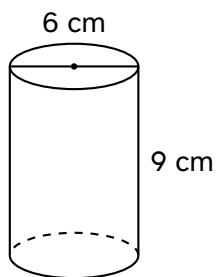


Diagram **NOT** accurately drawn

Work out the total surface area of the can.

Give your answer correct to 1 decimal place.

The diameter is 6 cm, so the radius is 3 cm.

A closed can has three faces: two circles and a curved surface.

$$\text{Two circles: } 2 \times \pi \times 3^2 = 18\pi$$

$$\text{Curved surface} = 2\pi rh = 2 \times \pi \times 3 \times 9 = 54\pi$$

$$\text{Total} = 18\pi + 54\pi = 72\pi$$

$$72\pi = 226.19 \dots$$

Round to 1 decimal place: 226.2

Answer: 226.2 cm²

Tip: “Closed” means the can has a top and a bottom, so include **two** circles. Use the radius (3 cm), not the diameter.

Marks: 1 mark for the two circles, $2\pi r^2$. 1 mark for the curved surface, $2\pi rh$. 1 mark for 226.2.

4 (3 marks)

A cylinder has a volume of 800 cm³ and a height of 10 cm.

Work out the radius of the cylinder.

Give your answer correct to 3 significant figures.

$$\text{Volume} = \pi r^2 h, \text{ so } \pi \times r^2 \times 10 = 800$$

$$\text{Divide both sides by 10: } \pi r^2 = 80$$

Divide both sides by π : $r^2 = 80 \div \pi = 25.46 \dots$

Square root: $r = \sqrt{25.46 \dots} = 5.046 \dots$

Round to 3 significant figures: 5.05

Answer: 5.05 cm

Marks: 1 mark for $\pi r^2 \times 10 = 800$. 1 mark for $r^2 = 25.4 \dots$ (or $80 \div \pi$). 1 mark for 5.05.

5 (3 marks)

The diagram shows a block of cheese in the shape of a cylinder.

The cylinder has radius 6 cm and height 8 cm.

The density of the cheese is 1.1 g/cm^3

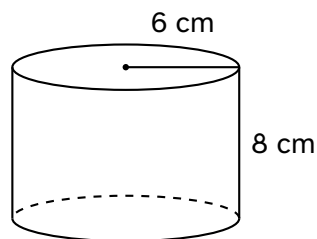


Diagram **NOT** accurately drawn

Work out the mass of the cheese.

Give your answer correct to 3 significant figures.

First find the volume of the cylinder.

$$\text{Volume} = \pi \times 6^2 \times 8 = 904.77 \dots \text{ cm}^3$$

$$\text{Mass} = \text{density} \times \text{volume}$$

$$= 1.1 \times 904.77 \dots = 995.25 \dots$$

Round to 3 significant figures: 995

Answer: 995 g

Tip: Mass = density $\times$ volume. Dividing the volume by the density (giving 823) is a common mistake: check that your answer makes sense.

Marks: 1 mark for $\pi \times 6^2 \times 8$. 1 mark for $1.1 \times$ your volume. 1 mark for 995.

6 (4 marks)

A cylinder with radius 5 cm and height 20 cm is full of water.
All the water is poured into an empty tank in the shape of a cuboid.
The base of the tank is 30 cm by 20 cm.

Work out the depth of the water in the tank.
Give your answer correct to 1 decimal place.

$$\text{Volume of water} = \pi \times 5^2 \times 20 = 1570.79 \dots \text{ cm}^3$$

The same volume of water goes into the tank.

$$\text{Area of the tank's base} = 30 \times 20 = 600 \text{ cm}^2$$

Volume = base area $\times$ depth, so depth = volume $\div$ base area

$$\text{Depth} = 1570.79 \dots \div 600 = 2.61 \dots$$

Round to 1 decimal place: 2.6

Answer: 2.6 cm

Marks: 1 mark for the volume of the cylinder. 1 mark for 600. 1 mark for dividing the volume by 600. 1 mark for 2.6.

7 (4 marks)

A water butt is in the shape of a cylinder.

It has radius 30 cm and height 90 cm.

The water butt is full of water.

Water is drained out of the water butt at a rate of 4 litres per minute.

1 litre = 1000 cm³

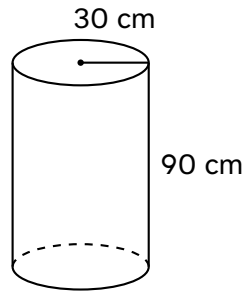


Diagram **NOT** accurately drawn

Work out the depth of the water left in the water butt after 20 minutes.

Give your answer correct to 1 decimal place.

You must show all your working.

Water drained in 20 minutes = $20 \times 4 = 80$ litres

80 litres = $80 \times 1000 = 80\,000$ cm³

Area of the circular base = $\pi \times 30^2 = 2827.43 \dots$ cm²

Fall in depth = $80\,000 \div 2827.43 \dots = 28.29 \dots$ cm

Depth left = $90 - 28.29 \dots = 61.70 \dots$

Round to 1 decimal place: 61.7

Answer: 61.7 cm

Tip: Change litres to cm³ before you divide by the base area: 1 litre = 1000 cm³. The question asks for the depth **left**, so subtract from 90 cm.

Marks: 1 mark for 80 000 cm³ (or 80 litres). 1 mark for $\pi \times 30^2$ (or the full volume 254 469 cm³). 1 mark for $80\,000 \div 2827.4 \dots$ (or $174\,469 \div 2827.4 \dots$). 1 mark for 61.7.

8 (4 marks)

Ayesha fills plant pots with a mixture of compost and sand.

Each pot is a cylinder with radius 12 cm and height 25 cm.

She fills 20 pots completely.

The mixture is compost and sand in the ratio 4:1 by volume.

Compost is sold in 50-litre bags.

1 litre = 1000 cm³

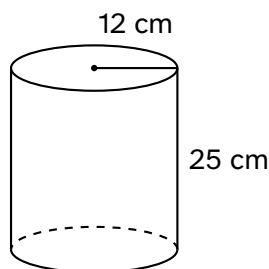


Diagram **NOT** accurately drawn

How many bags of compost does Ayesha need to buy?

You must show how you get your answer.

$$\text{Volume of one pot} = \pi \times 12^2 \times 25 = 11\,309.7 \dots \text{ cm}^3$$

$$\text{Volume of 20 pots} = 20 \times 11\,309.7 \dots = 226\,194.6 \dots \text{ cm}^3$$

Change to litres (divide by 1000): 226.19 ... litres

The ratio 4:1 has 4 + 1 = 5 parts, and 4 parts are compost.

$$\text{Compost needed} = \frac{4}{5} \times 226.19 \dots = 180.95 \dots \text{ litres}$$

$$\text{Number of bags} = 180.95 \dots \div 50 = 3.6 \dots$$

3 bags are not enough, so she must buy 4 bags.

Answer: 4 bags

Tip: Round **up**: 3.6 bags means 3 bags are not enough. Also, 4:1 has 5 parts in total, so compost is $\frac{4}{5}$, not $\frac{1}{4}$.

Marks: 1 mark for $\pi \times 12^2 \times 25$. 1 mark for multiplying by 20 and dividing by 1000. 1 mark for $\frac{4}{5}$ of the total (180.9...). 1 mark for 4 bags.