

Surface Area of Prisms and Cylinders

Solutions

For AQA GCSE Mathematics (8300) • 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 (1 mark)

A cube has edges of length 3 cm.

Circle the total surface area of the cube.

Options: 9 cm², 27 cm², 36 cm², 54 cm²

A cube has 6 faces, and they are all squares.

Area of one face = $3 \times 3 = 9 \text{ cm}^2$

Total surface area = $6 \times 9 = 54 \text{ cm}^2$

Answer: 54 cm²

Tip: A cube has **6** faces, not 4. (27 cm³ is the volume.)

2 (2 marks)

Leah covers every face of a wooden cube with paper.

She uses exactly 216 cm² of paper, with no gaps and no overlaps.

Work out the length of one edge of the cube.

The paper covers the 6 faces of the cube, and they are all the same size.

Area of one face = $216 \div 6 = 36 \text{ cm}^2$

Each face is a square, so edge $\times$ edge = 36

$$\text{Edge} = \sqrt{36} = 6 \text{ cm}$$

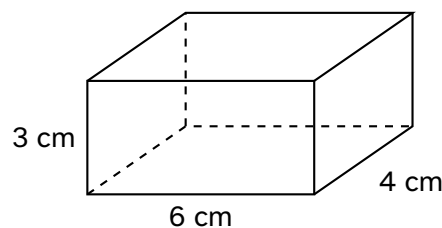
Answer: 6 cm

Tip: Divide by 6 because a cube has 6 faces, then take the square root. Dividing 36 by 4 is a common mistake.

Marks: 1 mark for 36. 1 mark for 6.

3 (3 marks)

Here is a cuboid.



Not drawn accurately

Work out the total surface area of the cuboid.

A cuboid has 6 faces, in 3 matching pairs.

Front and back: $6 \times 3 = 18 \text{ cm}^2$ each

Top and bottom: $6 \times 4 = 24 \text{ cm}^2$ each

Two ends: $4 \times 3 = 12 \text{ cm}^2$ each

Total = $2 \times (18 + 24 + 12)$

= $2 \times 54 = 108$

Answer: 108 cm^2

Marks: 1 mark for the areas of two different faces. 1 mark for adding all six faces. 1 mark for 108.

4 (3 marks)

An open box (no lid) is a cuboid 20 cm long, 15 cm wide and 10 cm high.

Work out the area of cardboard needed to make the box.

The box has no lid, so it has only 5 faces.

Base: $20 \times 15 = 300 \text{ cm}^2$

Front and back: $2 \times 20 \times 10 = 400 \text{ cm}^2$

Two sides: $2 \times 15 \times 10 = 300 \text{ cm}^2$

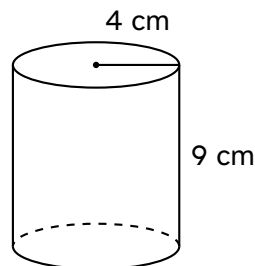
Total = $300 + 400 + 300 = 1000 \text{ cm}^2$

Answer: 1000 cm^2

Marks: 1 mark for the areas of at least 3 faces. 1 mark for adding 5 faces only. 1 mark for 1000.

5 (3 marks)

A solid cylinder has radius 4 cm and height 9 cm.



Not drawn accurately

Work out the total surface area of the cylinder.

Give your answer in terms of π .

A solid cylinder has two circles and one curved surface.

Two circles: $2 \times \pi \times 4^2 = 32\pi$

Curved surface = $2\pi rh = 2 \times \pi \times 4 \times 9 = 72\pi$

$$\text{Total} = 32\pi + 72\pi = 104\pi$$

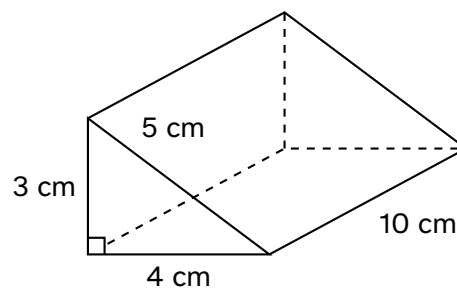
Answer: $104\pi \text{ cm}^2$

Tip: Remember there are **two** circles, one at each end. Many students include only one.

Marks: 1 mark for 32π . 1 mark for 72π . 1 mark for 104π .

6 (4 marks)

The cross-section of this prism is a right-angled triangle with sides 3 cm, 4 cm and 5 cm.



Not drawn accurately

Work out the total surface area of the prism.

The prism has 5 faces: 2 triangles and 3 rectangles.

$$\text{One triangle} = \frac{1}{2} \times 3 \times 4 = 6 \text{ cm}^2$$

$$\text{Two triangles} = 2 \times 6 = 12 \text{ cm}^2$$

$$\text{Rectangles: } 3 \times 10 = 30, 4 \times 10 = 40, 5 \times 10 = 50$$

$$\text{Three rectangles} = 30 + 40 + 50 = 120 \text{ cm}^2$$

$$\text{Total} = 12 + 120 = 132 \text{ cm}^2$$

Answer: 132 cm^2

Marks: 1 mark for the two triangles. 1 mark for one rectangle. 1 mark for adding all 5 faces. 1 mark for 132.

7 (3 marks)

A wooden toy box is a closed cuboid 80 cm long, 60 cm wide and 50 cm high.

Rosa paints all six outside faces of the box.

Work out the total area she paints.

Give your answer in square metres.

Change to metres first: 80 cm = 0.8 m, 60 cm = 0.6 m, 50 cm = 0.5 m

Top and bottom: $2 \times 0.8 \times 0.6 = 0.96 \text{ m}^2$

Front and back: $2 \times 0.8 \times 0.5 = 0.8 \text{ m}^2$

Two ends: $2 \times 0.6 \times 0.5 = 0.6 \text{ m}^2$

Total = $0.96 + 0.8 + 0.6 = 2.36 \text{ m}^2$

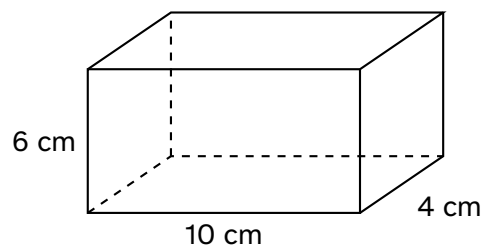
Answer: 2.36 m²

Tip: Change cm to m **before** you work out the areas. If you work in cm² (23 600 cm²), divide by 10 000, not 100, to change to m².

Marks: 1 mark for the area of one face (in cm² or m²). 1 mark for the total 23 600 cm² or a full method in m². 1 mark for 2.36.

8 (3 marks)

Here is a cuboid.



Not drawn accurately

Sam says,

‘If I double every length of this cuboid, its total surface area will double.’

Is Sam correct?

You must show your working.

Surface area of the cuboid:

$$2 \times (10 \times 6) + 2 \times (10 \times 4) + 2 \times (6 \times 4) = 120 + 80 + 48 = 248 \text{ cm}^2$$

Double every length: 20 cm by 12 cm by 8 cm

$$2 \times (20 \times 12) + 2 \times (20 \times 8) + 2 \times (12 \times 8) = 480 + 320 + 192 = 992 \text{ cm}^2$$

Double 248 is 496, but the new surface area is 992.

$992 \div 248 = 4$, so the surface area is multiplied by 4, not 2.

Sam is not correct.

Answer: No. 248 cm^2 becomes 992 cm^2 , which is 4 times as big

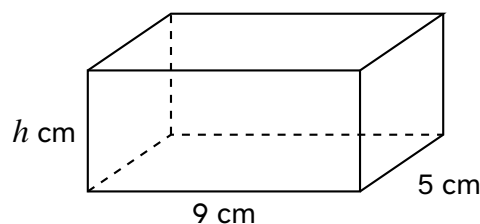
Tip: Each face is a rectangle. Doubling both of its sides multiplies its area by $2 \times 2 = 4$.

Marks: 1 mark for 248. 1 mark for 992. 1 mark for No, with a comparison (e.g. $992 \neq 2 \times 248$).

9 (4 marks)

Here is a cuboid.

It is 9 cm long, 5 cm wide and h cm high.



Not drawn accurately

- (a) The total surface area of the cuboid is 230 cm^2
Work out the value of h .

Top and bottom: $2 \times 9 \times 5 = 90 \text{ cm}^2$

The other four faces have area $230 - 90 = 140 \text{ cm}^2$

These are two faces $9 \times h$ and two faces $5 \times h$:

$$2 \times 9h + 2 \times 5h = 18h + 10h = 28h$$

$$28h = 140$$

$$h = 140 \div 28 = 5$$

Answer: $h = 5$

Tip: Write the area of each pair of faces. There are two $9 \times h$ faces and two $5 \times h$ faces.

Marks: 1 mark for 90 (the top and bottom). 1 mark for $28h = 140$ (or $140 \div 28$). 1 mark for 5.

- (b) Work out the volume of the cuboid.

$$\text{Volume} = 9 \times 5 \times 5 = 225 \text{ cm}^3$$

Answer: 225 cm^3