Surface area and volume

Worked solutions

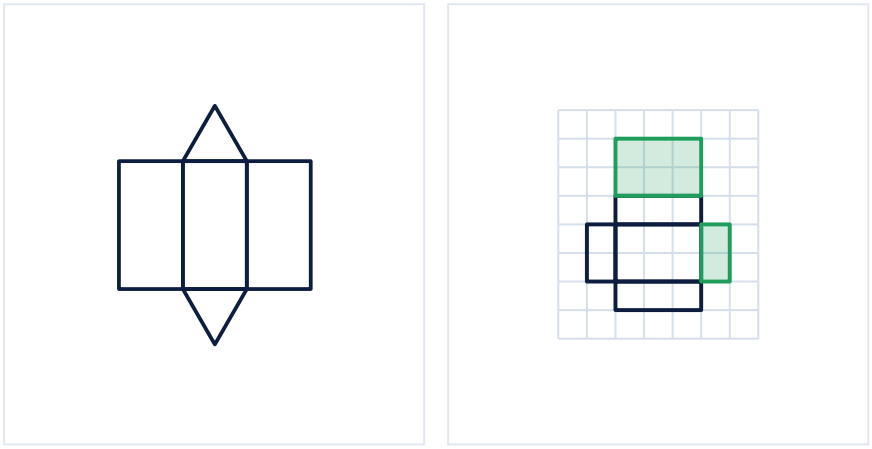
KS3 Maths topic practice

This topic online

1

a. Diagram **a** shows the net of a 3D solid. Write down the name of the solid.

b. Diagram **b** shows part of the net of a cuboid that measures 3 cm by 2 cm by 1 cm, drawn on a centimetre grid. Two faces are missing. On the grid, draw the two missing faces to complete the net.



a *b*

(3 marks)

a) 2 triangles + 3 rectangles

triangular prism

b) a cuboid has 3 pairs of faces

given: one 3 by 2, one 1 by 2, two 3 by 1

missing: a 1 by 2 face and a 3 by 2 face

1 by 2 goes on the right of the 3 by 2 face

3 by 2 goes on top of the top 3 by 1 face

net complete: 6 faces

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2 A cuboid measures 5 cm by 3 cm by 2 cm.

Work out the total surface area of the cuboid.

State the units of your answer.

(3 marks)

The three different faces have areas $5 \times 3 = 15$ cm^2, $5 \times 2 = 10$ cm^2 and $3 \times 2 = 6$ cm^2

Each face appears twice, so total surface area $= 2 \times (15 + 10 + 6)$

Total surface area $= 2 \times 31 = 62$ cm^2

$\boxed{62 \text{ cm}^2}$

3 The cross-section of a prism is a trapezium.

The parallel sides of the trapezium are 6 cm and 10 cm, and the perpendicular distance between them is 4 cm.

The length of the prism is 15 cm.

Work out the volume of the prism.

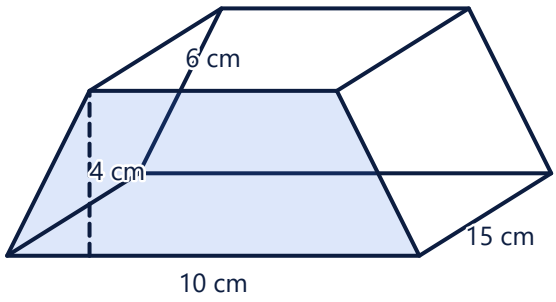

Diagram NOT accurately drawn

(3 marks)

Area of the trapezium $= \frac{1}{2} \times (6 + 10) \times 4 = \frac{1}{2} \times 16 \times 4 = 32$ cm^2

Volume of a prism = area of cross-section x length

Volume $= 32 \times 15 = 480$ cm^3

$\boxed{480 \text{ cm}^3}$

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4 A cylinder has a radius of 5 cm and a height of 12 cm.

Work out the volume of the cylinder.

Give your answer correct to 3 significant figures.

(3 marks)

The circular cross-section has area πr^2. Multiplying by the perpendicular height gives the volume, just as base area x height does for a cuboid

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

Volume = $\pi \times 5^2 \times 12 = 300\pi$

Volume = $942.477... = 942 \text{ cm}^3$ (3 significant figures)

942 cm^3

5 A garden pond is a cuboid 2.5 m long, 1.2 m wide and 0.6 m deep.

The pond is filled with water from a hose. Water flows from the hose at 15 litres per minute.

Work out how long it takes to fill the pond. Give your answer in hours.

1 m^3 = 1000 litres

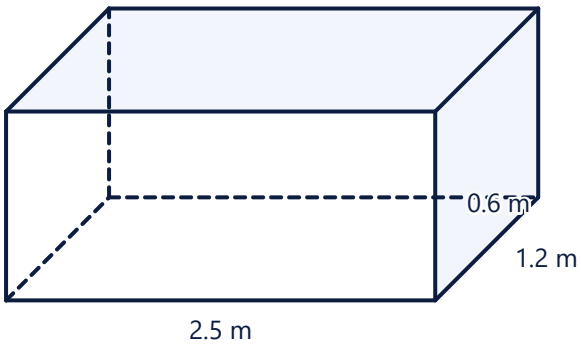

Diagram NOT accurately drawn

(3 marks)

volume = length x width x depth

$V = 2.5 \times 1.2 \times 0.6$

$V = 1.8 \text{ m}^3$

$1.8 \times 1000 = 1800$ litres

$1800 \div 15 = 120$ minutes

2 hours

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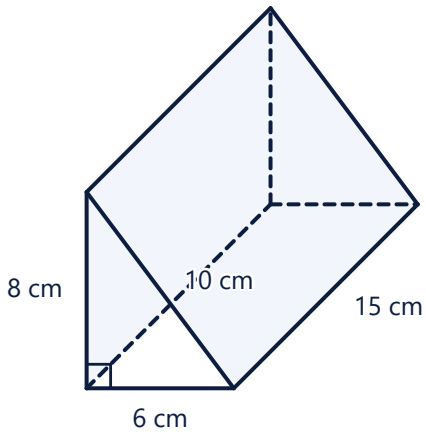
6 The diagram shows a triangular prism. The cross-section is a right-angled triangle with sides 6 cm, 8 cm and 10 cm. The prism is 15 cm long.

a. Work out the volume of the prism.

b. Work out the total surface area of the prism.



(4 marks)

a) area of cross-section

$$A = \frac{1}{2} \times 6 \times 8$$

$$A = 24$$

$$V = 24 \times 15$$

$$\boxed{V = 360 \text{ cm}^3}$$

b) 2 triangles + 3 rectangles

$$2 \times 24 = 48$$

$$6 \times 15 = 90$$

$$8 \times 15 = 120$$

$$10 \times 15 = 150$$

$$48 + 90 + 120 + 150 = 408$$

$$\boxed{408 \text{ cm}^2}$$

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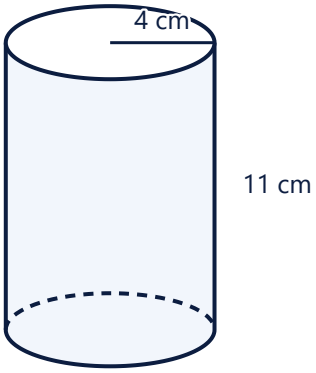
7 A tin of beans is a closed cylinder with radius 4 cm and height 11 cm.

a. A paper label covers the curved surface of the tin. Work out the area of the label.

b. Work out the total surface area of the tin.

Give your answers correct to 1 decimal place.



(4 marks)

a) curved surface = circumference x height

$C = 2 \times \pi \times 4 = 8\pi$

$A = 8\pi \times 11$

$A = 88\pi = 276.46...$

$276.5\ cm^2$

b) add the two circles

$\pi \times 4^2 = 16\pi$

$2 \times 16\pi = 32\pi$

$88\pi + 32\pi = 120\pi$

$120\pi = 376.99...$

$377.0\ cm^2$

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8 A cylindrical water butt has a radius of 25 cm and a height of 80 cm.

Work out the number of litres of water the water butt holds when it is full.

Give your answer to the nearest litre.

1 litre = 1000 cm^3

(4 marks)

Volume $= \pi r^2 h = \pi \times 25^2 \times 80 = 50000\pi \ cm^3$

Volume $= 157079.6... \ cm^3$

$157079.6 \div 1000 = 157.08$ litres

The water butt holds 157 litres (nearest litre)

157 litres

9 A cube has a total surface area of 150 cm^2.

Show that the volume of the cube is 125 cm^3.

(4 marks)

A cube has 6 identical square faces, so each face has area $150 \div 6 = 25 \ cm^2$

The side length is $\sqrt{25} = 5$ cm

Volume $= 5 \times 5 \times 5 = 125 \ cm^3$

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10 A skate ramp is made of concrete. It is a triangular prism. The cross-section is a right-angled triangle with base 3 m and height 1.2 m. The ramp is 2.5 m wide.

Concrete costs £95 per m^3.

Work out the cost of the concrete for the ramp.

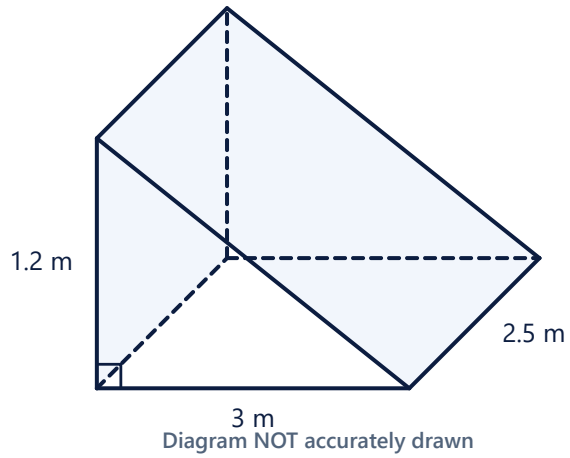

Diagram NOT accurately drawn

(3 marks)

area of cross-section

$$A = \frac{1}{2} \times 3 \times 1.2$$

$$A = 1.8 \text{ m}^2$$

$$V = 1.8 \times 2.5$$

$$V = 4.5 \text{ m}^3$$

$$4.5 \times 95 = 427.50$$

£427.50

11 A closed wooden box is a cuboid measuring 40 cm by 25 cm by 20 cm.

Amira varnishes all 6 faces of each box.

One tin of varnish covers 5000 cm^2.

Amira has 3 tins of varnish.

Work out the greatest number of boxes Amira can varnish completely.

(4 marks)

Surface area of one box = $2 \times (40 \times 25 + 40 \times 20 + 25 \times 20) = 2 \times (1000 + 800 + 500) = 4600 \text{ cm}^2$

3 tins cover $3 \times 5000 = 15000 \text{ cm}^2$

$15000 \div 4600 = 3.26...$, so Amira can varnish 3 complete boxes

3

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12 A hall has 8 cylindrical pillars.

Each pillar has a radius of 0.25 m and a height of 3 m.

Ben paints the curved surface of every pillar.

One tin of paint covers 8 m^2.

Work out the number of tins of paint Ben must buy.

(4 marks)

Curved surface area of one pillar = $2\pi rh = 2 \times \pi \times 0.25 \times 3 = 1.5\pi = 4.712... \ m^2$

Total area for 8 pillars = $8 \times 1.5\pi = 12\pi = 37.699... \ m^2$

$37.699... \div 8 = 4.71...$, so 4 tins are not enough

Ben must buy 5 tins

5

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