Volume and Surface Area of a Prism

Remember:

A prism is a 3D shape which has a constant cross-section.

The formula for the volume of a prism is:

volume = area of cross-section × length

The surface area of a prism is the combined area of all of its faces.

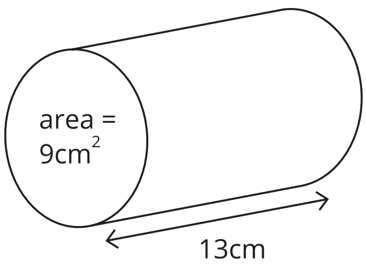
Bronze

1. The diagrams show some prisms with a given cross-sectional area.

   Calculate the volume of each prism.

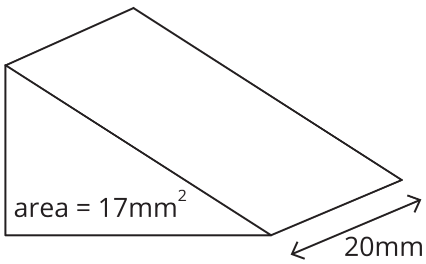
   Give the correct units in your answers.

a.



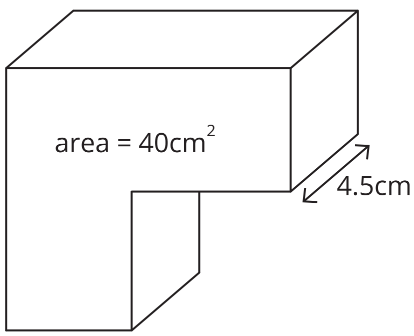
Volume =

b.



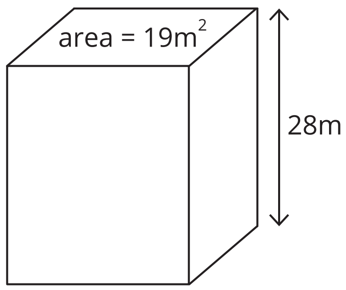
Volume =

c.



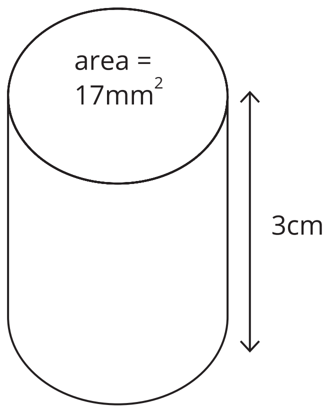
Volume =

d.



Volume =

e.



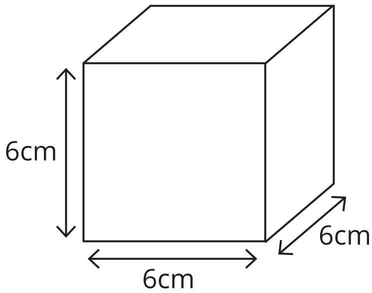
Volume =

2. The diagrams show some cuboids.

   Calculate the volume and surface area of each cuboid.

   Give the correct units in your answers.

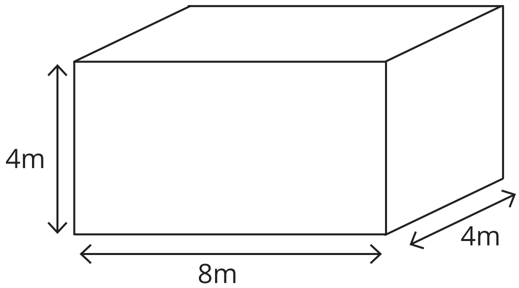
a.



Volume =

Surface area =

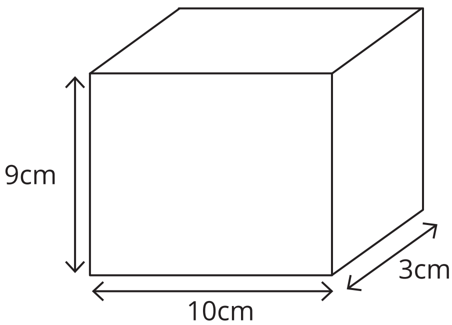
b.



Volume =

Surface area =

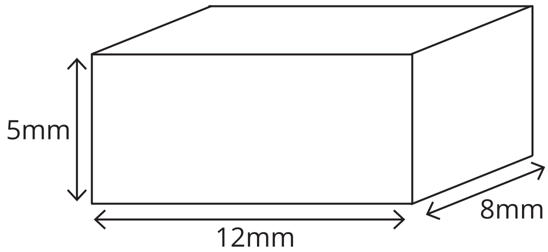
c.



Volume =

Surface area =

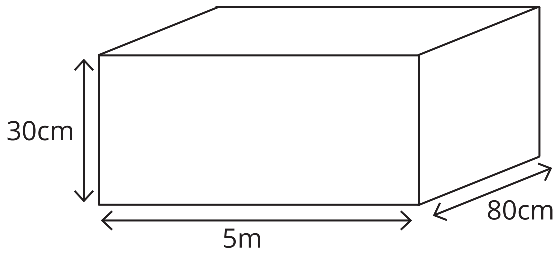
d.



Volume =

Surface area =

e.



Volume =

Surface area =

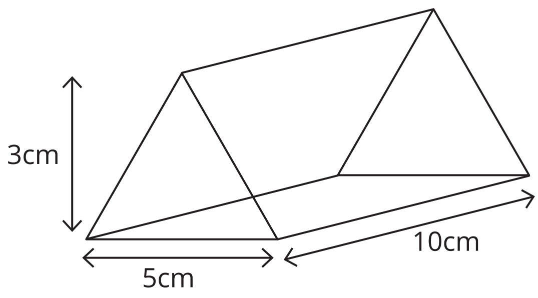
Silver

3. The diagrams show some prisms.

Calculate the volume of each prism.

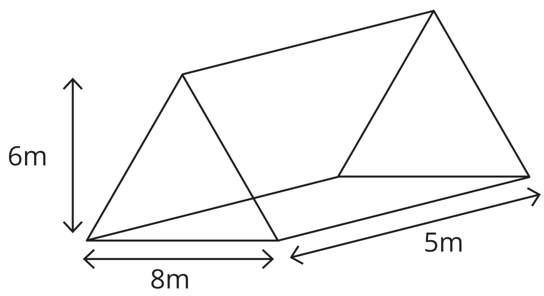
Give the correct units in your answers.

a.



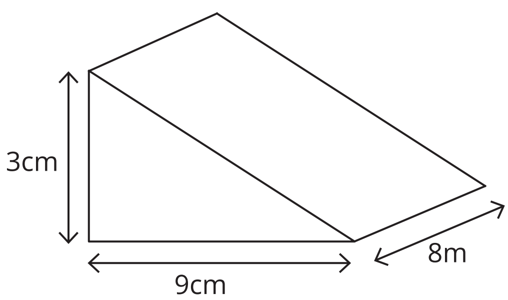
Volume =

b.



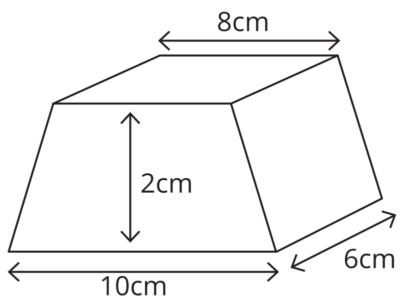
Volume =

c.



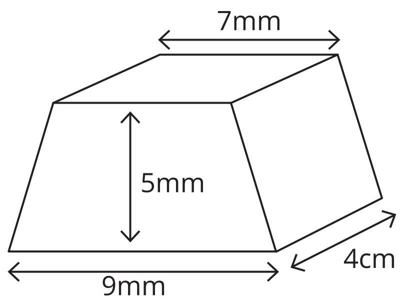
Volume =

d.



Volume =

e.



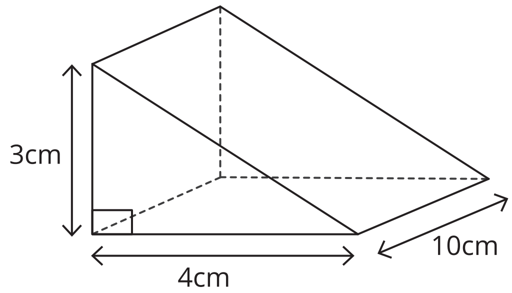
Volume =

4. The diagrams show some right triangular prisms.

   Use Pythagoras' theorem to calculate the length of the hypotenuse, then calculate the surface area of each prism.

   Give your answers in cm^2 to 2 decimal places where necessary.

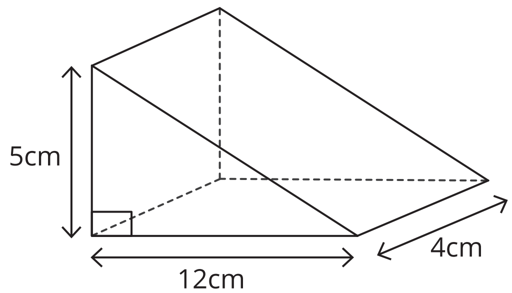
a.



Hypotenuse =

Surface area =

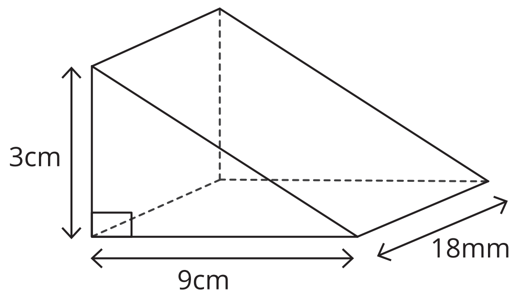
b.



Hypotenuse =

Surface area =

c.

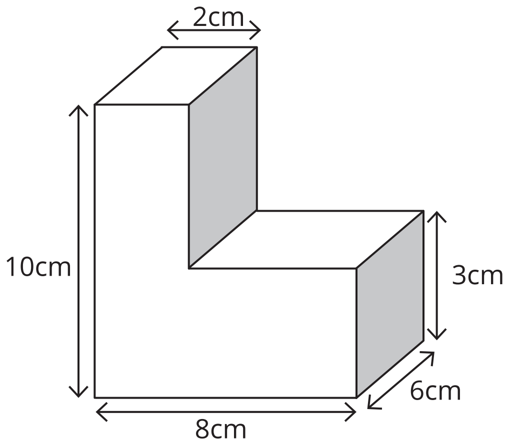


Hypotenuse =

Surface area =

5. The diagrams show some prisms of which the cross-section is a composite shape. Calculate the area of the cross-section, then calculate the volume of each prism. Give the correct units in your answers.

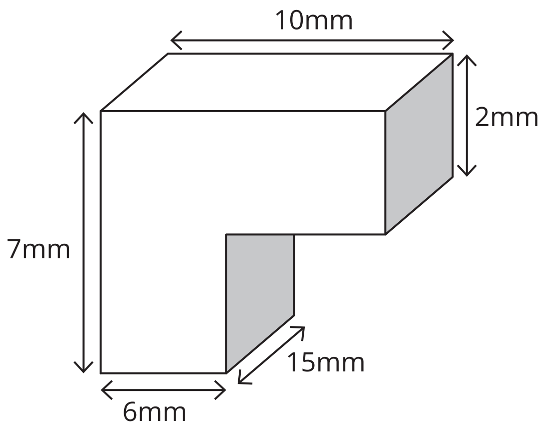
a.



Cross-sectional area =

Volume =

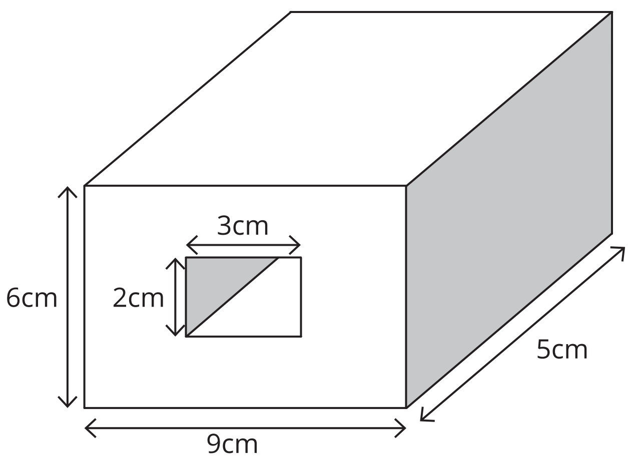
b.



Cross-sectional area =

Volume =

c.



Cross-sectional area =

Volume =

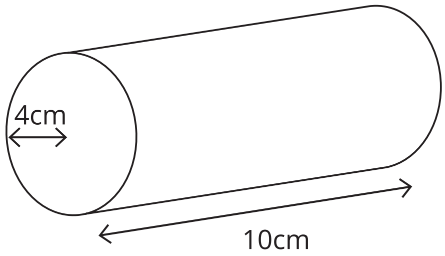
Gold

6. The diagrams show some solid cylinders and some partial solid cylinders.

   Calculate the volume and surface area of each shape.

   Give your answers in terms of π. Give the correct units in your answers.

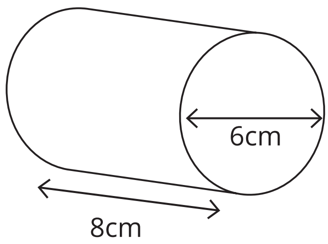
a.



Volume =

Surface area =

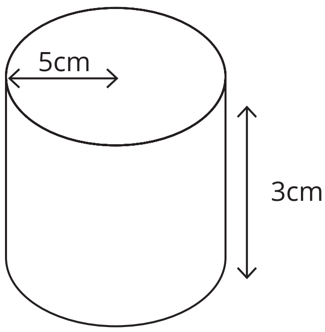
b.



Volume =

Surface area =

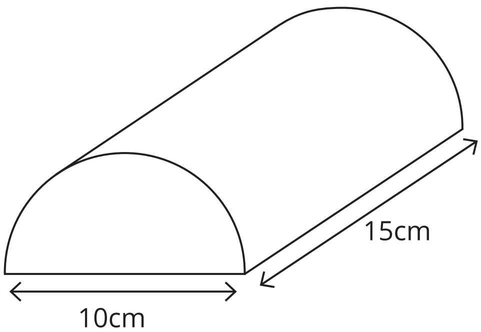
c.



Volume =

Surface area =

d.



Volume =

Surface area =

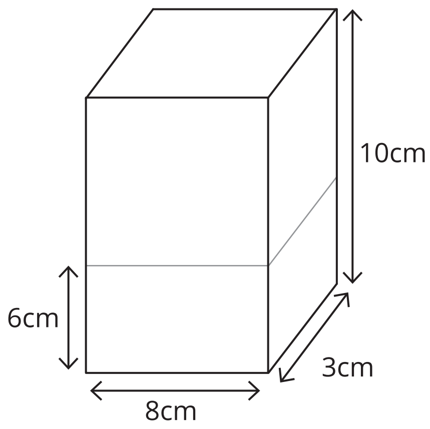
7. Mixed problems:

a. A cube has a surface area of $486cm^2$. Work out the side length of the cube.

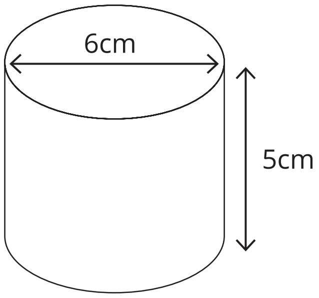
b. A cube has a volume of $343cm^3$. Work out the surface area of the cube.

c. A cylinder has a volume of $452.4cm^3$. The height of the cylinder is 9cm. Calculate the diameter of the cross-section.

d. A carton is stood on the face with the smallest area as shown. The liquid in the carton reaches a height of 6cm. The cuboid is flipped onto the face with the largest area. Work out the height the liquid now reaches.



e. The diagram shows a cylindrical vessel which is filled with water. The water is poured into a vase in the shape of a cube with a side length of 8cm. Work out the depth of the water in the vase. Give your answer to a suitable degree of accuracy.



f. A cube has a side length of 3.5cm and a mass of 0.8kg.
Calculate the density of the cube.
Give your answer in g/cm^3 to 2 decimal places.

Volume and Surface Area of a Prism **Answers**

Remember:

A prism is a 3D shape which has a constant cross-section.

The formula for the volume of a prism is:

volume = area of cross-section × length

The surface area of a prism is the combined area of all of its faces.

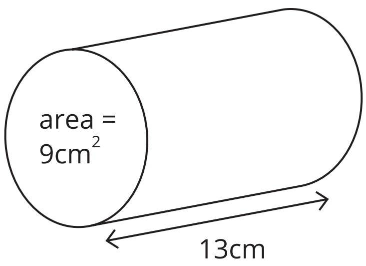
Bronze

1. The diagrams show some prisms with a given cross-sectional area.

   Calculate the volume of each prism.

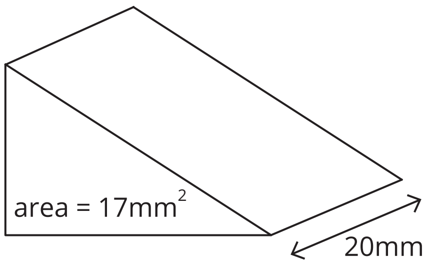
   Give the correct units in your answers.

a.



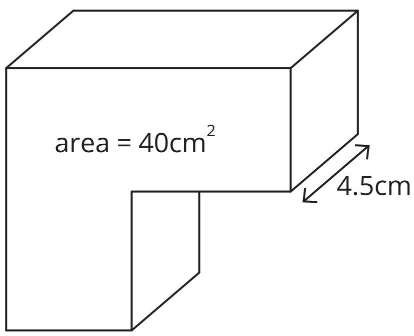
Volume = **9 × 13 = 117cm³**

b.



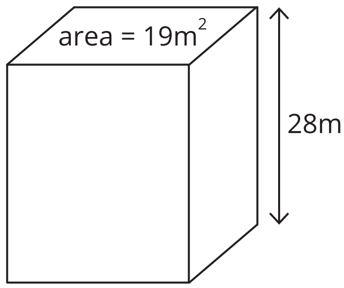
Volume = **17 × 20 = 340mm³**

c.



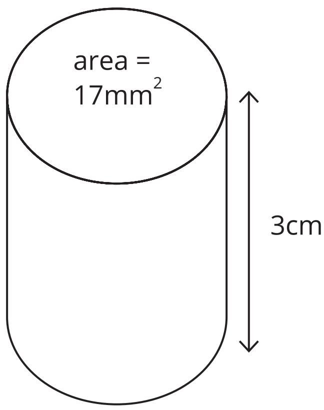
Volume = **40 × 4.5 = 180cm³**

d.



Volume = **19 × 28 = 532m³**

e.



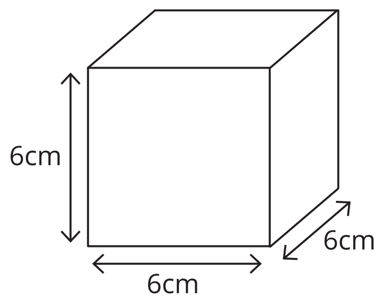
Volume = **17 × 30 = 510mm³**

2. The diagrams show some cuboids.

   Calculate the volume and surface area of each cuboid.

   Give the correct units in your answers.

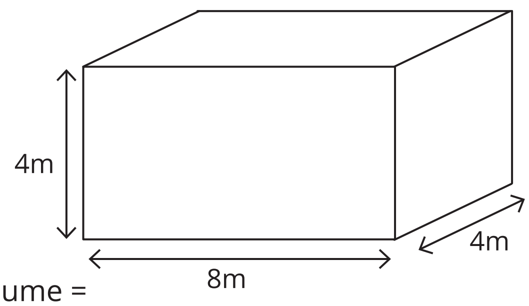
a.



Volume = **6^3 = 216cm^3**

Surface area = **6 × 6^2 = 216cm^2**

b.



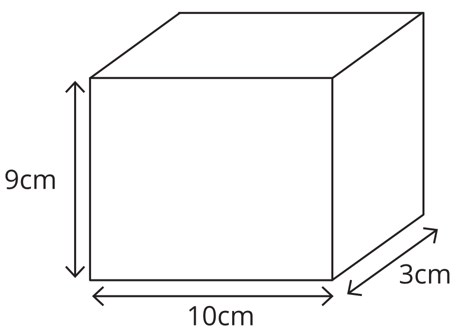
Volume =

4 × 4 × 8 = 128m^3

Surface area =

(2 × 4 × 4) + (4 × 4 × 8) = 160m^2

c.



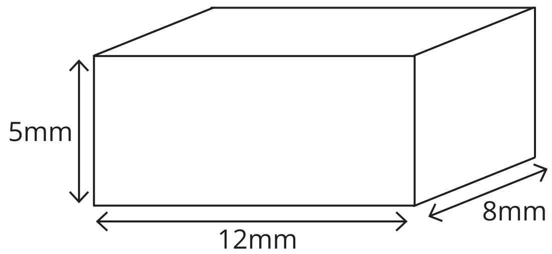
Volume =

3 × 9 × 10 = 270cm^3

Surface area =

(2 × 3 × 9) + (2 × 3 × 10) + (2 × 9 × 10) = 294cm^2

d.

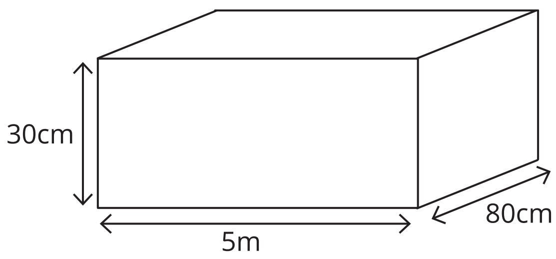


Volume = **8 × 5 × 12 = 480mm^3**

Surface area =

(2 × 8 × 5) + (2 × 8 × 12) + (2 × 5 × 12) = 392mm^2

e.



Volume =

500 × 30 × 80 = 1 200 000cm^3

or

5 × 0.3 × 0.8 = 1.2m^3

Surface area =

(2 × 500 × 30) + (2 × 500 × 80) + (2 × 30 × 80)

= 114 800cm^2

or

(2 × 5 × 0.3) + (2 × 5 × 0.8) + (2 × 0.3 × 0.8)

= 11.48m^2

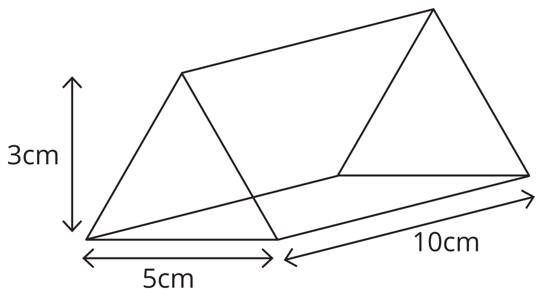
Silver

3. The diagrams show some prisms.

   Calculate the volume of each prism.

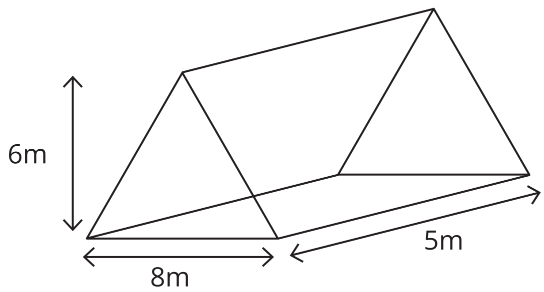
   Give the correct units in your answers.

a.



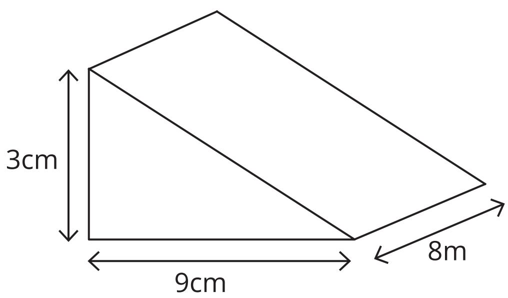
Volume = $\mathbf{(\frac{1}{2} \times 3 \times 5) \times 10 = 75cm^3}$

b.



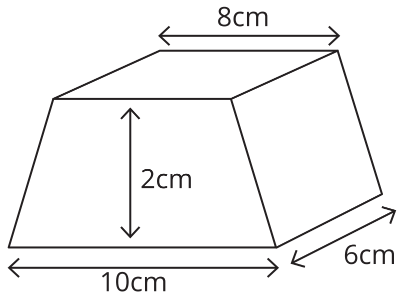
Volume = $\mathbf{(\frac{1}{2} \times 8 \times 6) \times 5 = 120m^3}$

c.



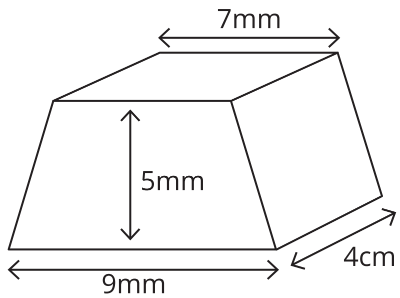
Volume = $\mathbf{(\frac{1}{2} \times 9 \times 3) \times 8 = 108cm^3}$

d.



Volume = $\mathbf{(\frac{1}{2} \times (8 + 10) \times 2) \times 6 = 108cm^3}$

e.



Volume = $\mathbf{(\frac{1}{2} \times (7 + 9) \times 5) \times 40 = 1600mm^3}$

or

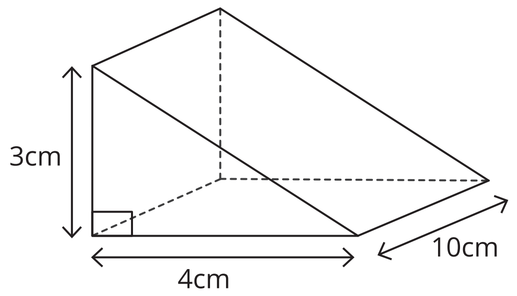
$\mathbf{(\frac{1}{2} \times (0.7 + 0.9) \times 0.5) \times 4 = 1.6cm^3}$

4. The diagrams show some right triangular prisms.

   Use Pythagoras' theorem to calculate the length of the hypotenuse, then calculate the surface area of each prism.

   Give your answers in cm^2 to 2 decimal places where necessary.

a.



Hypotenuse =

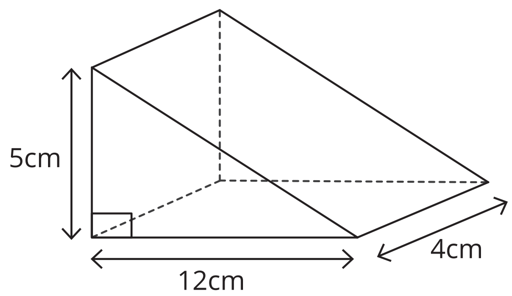
$\sqrt{3^2 + 4^2}$ **= 5cm**

Surface area =

$((\frac{1}{2} \times 4 \times 3) \times 2) + (4 \times 10) + (3 \times 10) + (5 \times 10)$

$= 132cm^2$

b.



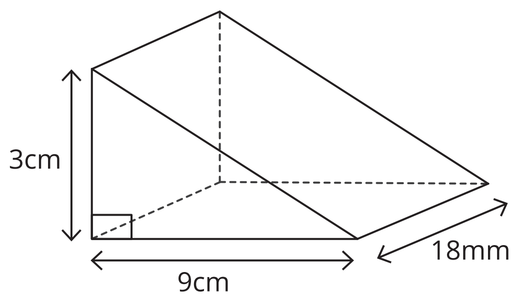
Hypotenuse = $\sqrt{5^2 + 12^2}$ **= 13cm**

Surface area =

$((\frac{1}{2} \times 12 \times 5) \times 2) + (12 \times 4) + (5 \times 4) + (13 \times 4)$

$= 180cm^2$

c.



Hypotenuse =

$\sqrt{9^2 + 3^2}$ **$= 3\sqrt{10}$cm = 9.49cm (2d.p)**

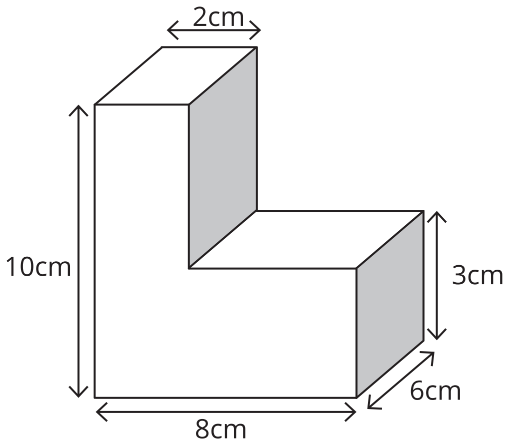
Surface area =

$((\frac{1}{2} \times 9 \times 3) \times 2) + (9 \times 1.8) + (3 \times 1.8) +$

$(9.49 \times 1.8) = 65.68cm^2$ (2d.p.)

5. The diagrams show some prisms of which the cross-section is a composite shape.
   Calculate the area of the cross-section, then calculate the volume of each prism.
   Give the correct units in your answers.

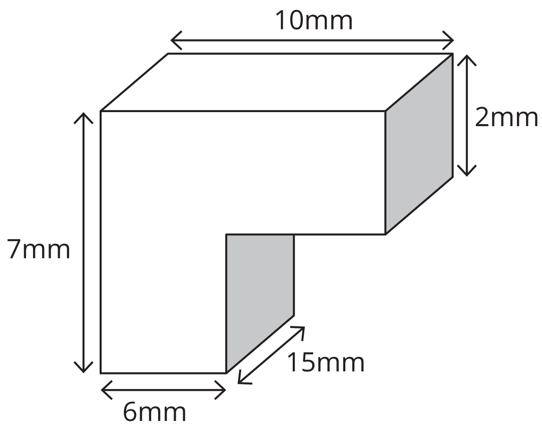
a.



Cross-sectional area =
(10 × 8) – (6 × 7) = 38cm^2

Volume = **38 × 6 = 228cm^3**

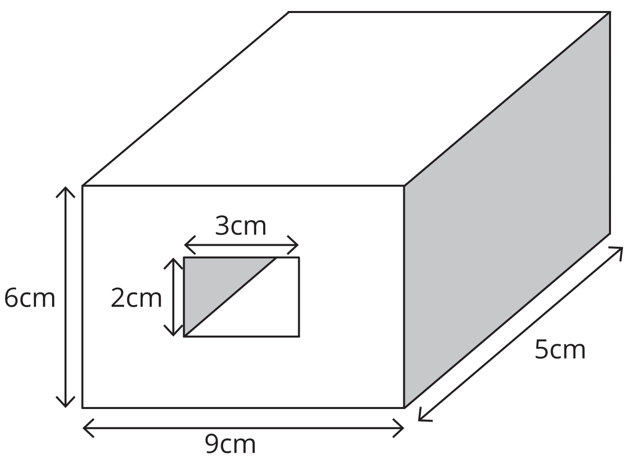
b.



Cross-sectional area =
(10 × 7) – (4 × 5) = 50mm^2

Volume = **50 × 15 = 750mm^3**

c.



Cross-sectional area =
(9 × 6) – (3 × 2) = 48cm^2

Volume = **48 × 5 = 240cm^3**

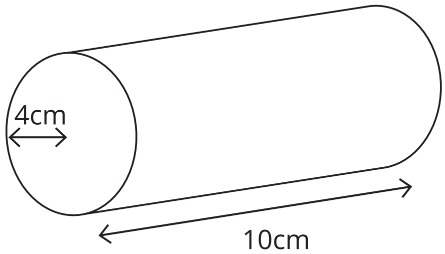
Gold

6. The diagrams show some solid cylinders and some partial solid cylinders.

   Calculate the volume and surface area of each shape.

   Give your answers in terms of π. Give the correct units in your answers.

a.



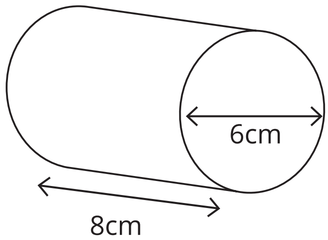
Volume = **$\pi \times 4^2 \times 10 = 160\pi \text{cm}^3$**

Surface area =

$(2 \times \pi \times 4 \times 10) + (2 \times \pi \times 4^2)$

$= 112\pi \text{cm}^2$

b.



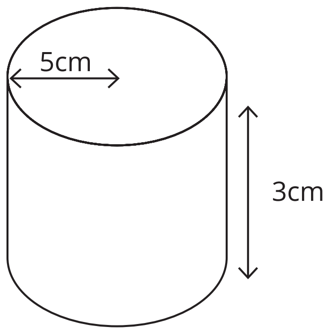
Volume = **$\pi \times 3^2 \times 8 = 72\pi \text{cm}^3$**

Surface area =

$(\pi \times 6 \times 8) + (2 \times \pi \times 3^2)$

$= 66\pi \text{cm}^2$

c.

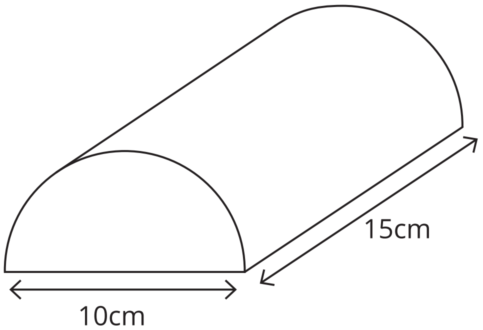


Volume = **$\pi \times 5^2 \times 3 = 75\pi \text{cm}^3$**

Surface area =

$(2 \times \pi \times 5 \times 3) + (2 \times \pi \times 5^2)$
$= 80\pi \text{cm}^2$

d.



Volume =

$\frac{1}{2} \times \pi \times 5^2 \times 15 = 187.5\pi \text{cm}^3$

Surface area =

$(\frac{1}{2} \times \pi \times 10 \times 15) + (\pi \times 5^2) + (10 \times 15)$

$= 100\pi + 150 \text{cm}^2$

7. Mixed problems:

a. A cube has a surface area of 486cm^2. Work out the side length of the cube.

$486 \div 6 = 81$

$\sqrt{81} = 9$cm

b. A cube has a volume of 343cm^3. Work out the surface area of the cube.

$\sqrt[3]{343} = 7$

$7^2 \times 6 = 294$cm^2

c. A cylinder has a volume of 452.4cm^3. The height of the cylinder is 9cm. Calculate the diameter of the cross-section.

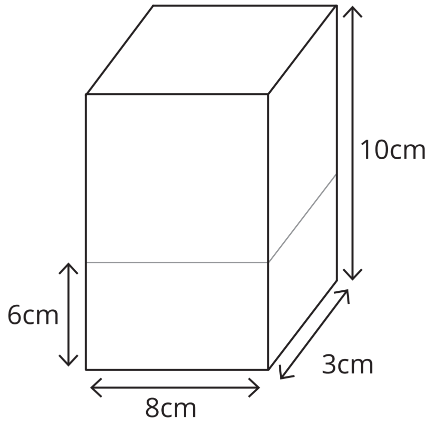
$452.4 \div 9 = 50.26...$

$50.26... \div \pi = 16.00...$

$\sqrt{16.00...} = 4.00...$

Diameter = $4 \times 2 = 8$cm

d. A carton is stood on the face with the smallest area as shown. The liquid in the carton reaches a height of 6cm. The cuboid is flipped onto the face with the largest area. Work out the height the liquid now reaches.

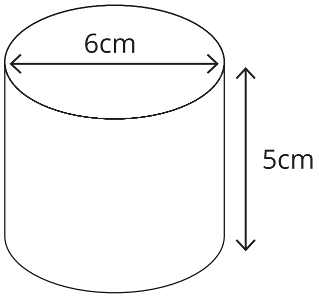


Volume of liquid = $8 \times 3 \times 6 = 144$cm^3

Area of largest face = $10 \times 8 = 80$cm^2

$144 \div 80 = 1.8$cm

e. The diagram shows a cylindrical vessel which is filled with water. The water is poured into a vase in the shape of a cube with a side length of 8cm. Work out the depth of the water in the vase. Give your answer to a suitable degree of accuracy.



Volume of cylinder = $\pi \times 3^2 \times 5 = 45\pi$cm^3

Cross-sectional area of cube = $8 \times 8 = 64$cm^2

$45\pi \div 64 = 2.21$cm (2d.p.)

f. A cube has a side length of 3.5cm and a mass of 0.8kg.

Calculate the density of the cube.

Give your answer in g/cm^3 to 2 decimal places.

Volume = $3.5^3 = 42.875$cm^3

Density = $800 \div 42.875 = 18.66$g/cm^3 (2d.p.)