

Student Name

Mathematics Stage 5 Core

AREA AND SURFACE AREA

Book 1 Solve problems involving areas and
surface areas

Version: 260207
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OVERVIEW

SYLLABUS CONTENT

MA5-ARE-C-01 solves problems involving the surface area of right prisms and practical problems involving the area of composite shapes and solids

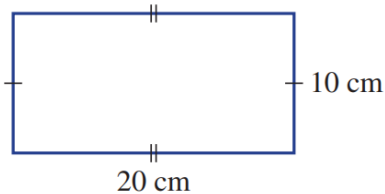
Solve problems involving areas and surface areas

- Solve practical problems involving the areas of composite shapes
- Identify the edge lengths and the faces making up the surface area of prisms
- Recognise and justify whether a diagram represents a net of a right prism
- Create and rearrange nets of right prisms
- Find the surface areas of prisms, given their nets, excluding curved surfaces
- Solve problems involving surface areas of prisms, excluding curved surfaces

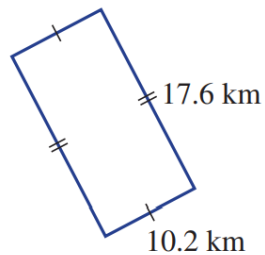
REVIEW OF PRIOR KNOWLEDGE

1 Calculate the area of these shapes.

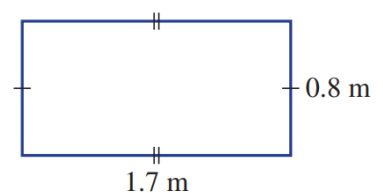
a



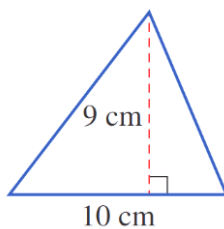
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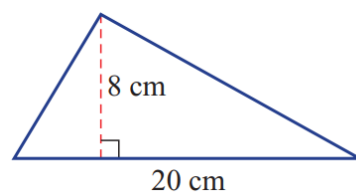
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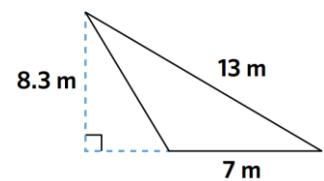
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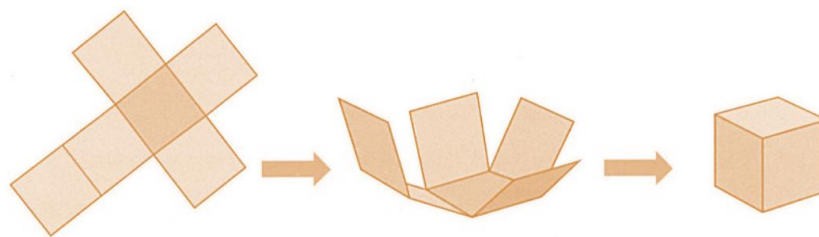


f



NETS OF 3D SOLIDS

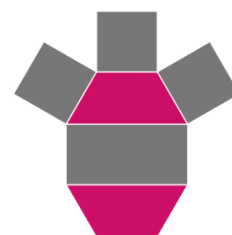
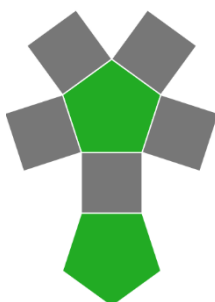
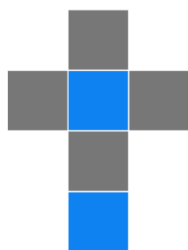
- A **net** shows a 3D shape's faces laid flat.



Example Recognise nets of a right prism.

Name the prism that is made from each net.

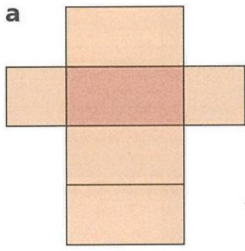
<https://mathigon.org/polypad/Qrx1t9V9RTSqA>



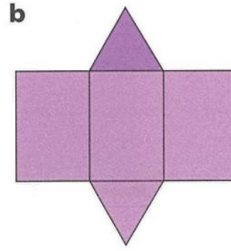
Key ideas

- The net of a prism always contains two shapes, which are connected by

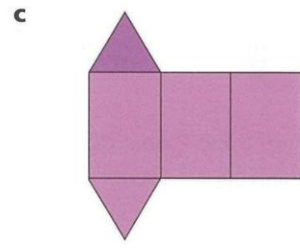
1 Give the name of each of the 3-D shapes that can be made from these nets.



Rectangular prism

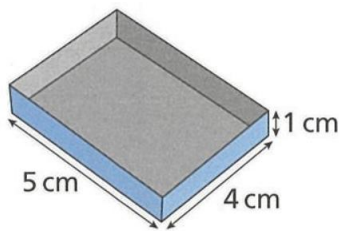


Triangular prism

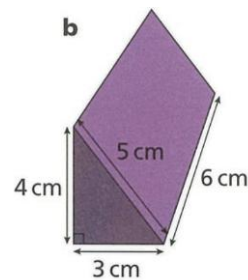
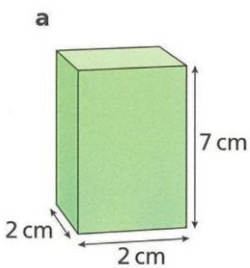


Triangular prism

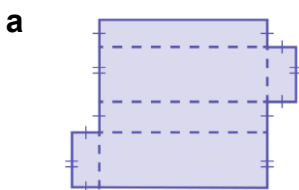
2 Sketch an accurate net for this open box.



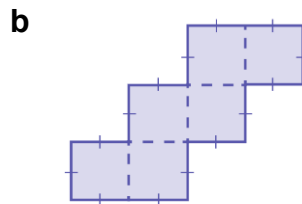
3 Sketch a net for each of these shapes.



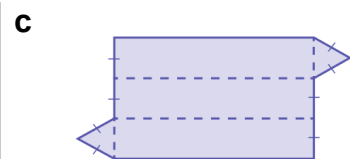
4 Name the solid made by the net.



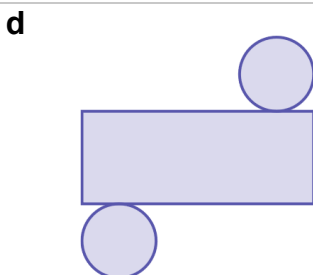
Rectangular prism



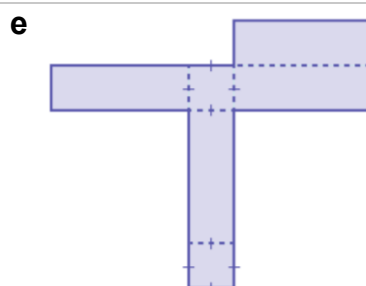
Cube



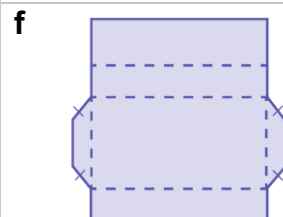
Triangular prism



Cylinder



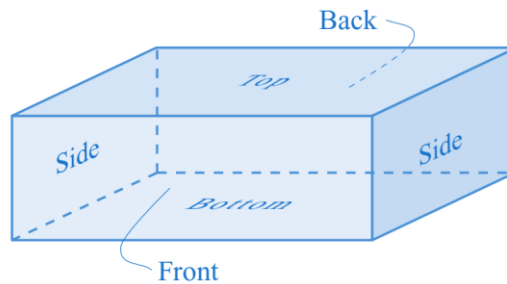
Square prism



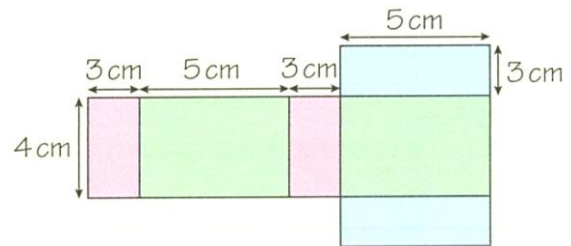
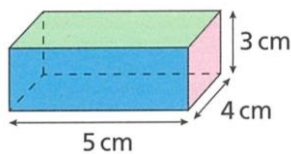
Trapezoidal prism

SURFACE AREA

- The **surface area** of a prism is the total area of all its faces.
- It equals the area of the prism's **net**.



Example Calculate surface area of prisms given their nets.



Area of front and back: $(5 \times 3) \times 2 = 30$

Area of sides: $(4 \times 3) \times 2 = 24$

Area of bottom and top: $(5 \times 4) \times 2 = 40$

Total surface area: $30 + 24 + 40 = 94 \text{ cm}^2$

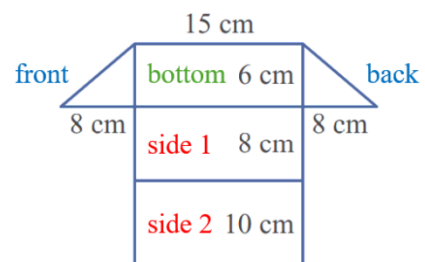
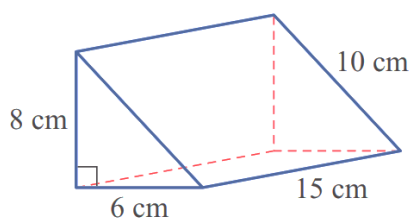
Describe what the surface area of a solid is.

Surface area is the area of all the of the solid.

Describe the method by which we calculate the surface area.

We can calculate the surface area by finding the area of the

Calculate the surface area of this triangular prism.



Area of front and back:

Area of side 1:

Area of side 2:

Area of bottom:

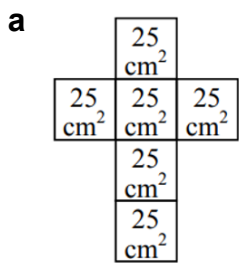
Total surface area:

408 cm^2

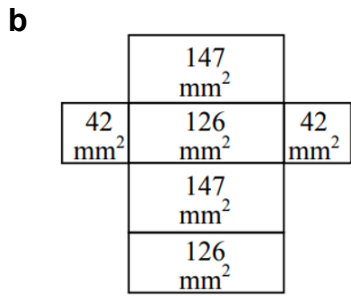
Key ideas

1. The of a prism is the area of the outer parts of the solid. It can be calculated by adding up the areas of all of the

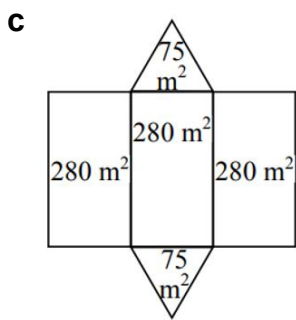
1 Find the surface area.



150 cm²

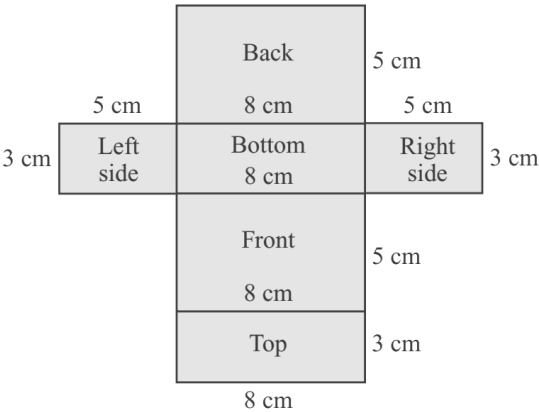
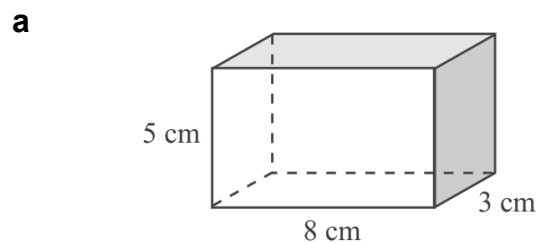


630 mm²



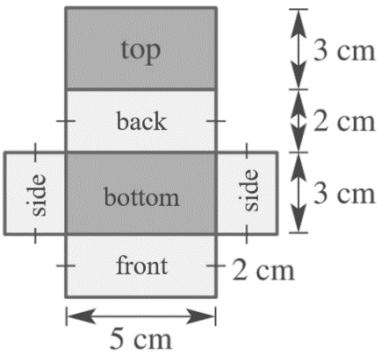
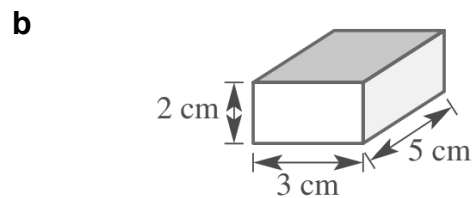
990 m²

2 Calculate the surface area of these prisms.



Area of front and back:
 $(5 \times 8) \times 2$
Area of sides:
 $(3 \times 5) \times 2$
Area of bottom and top:
 $(3 \times 8) \times 2$

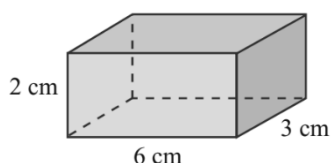
Total surface area:
=
158 cm²



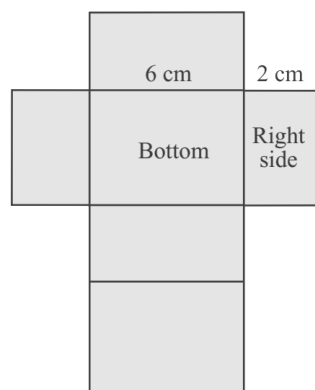
Area of front and back:
 $(3 \times 2) \times 2$
Area of sides:
 $(5 \times 2) \times 2$
Area of bottom and top:
 $(3 \times 5) \times 2$

Total surface area:
=
62 cm²

c

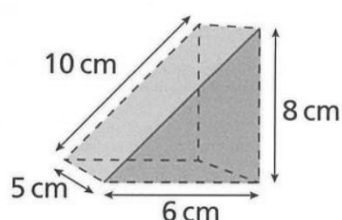


Area of front and back:
 $(6 \times 2) \times 2$
 Area of sides:
 $(3 \times 2) \times 2$
 Area of bottom and top:
 $(6 \times 3) \times 2$

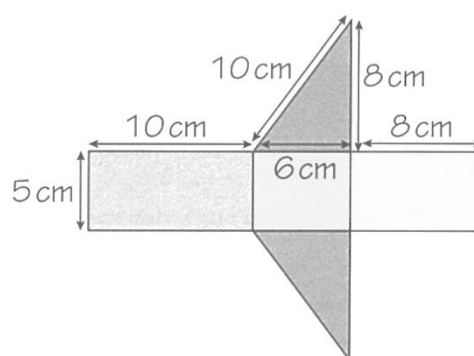


Total surface area:
 = 72 cm^2

d

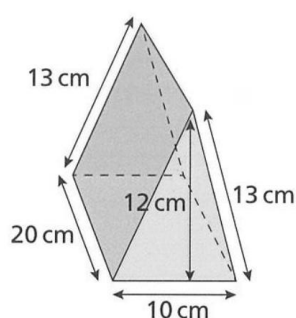


Area of front and back:
 $\left(\frac{6 \times 5}{2}\right) \times 2$
 Area of left side:
 5×10
 Area of right side:
 5×8
 Area of bottom:
 6×5

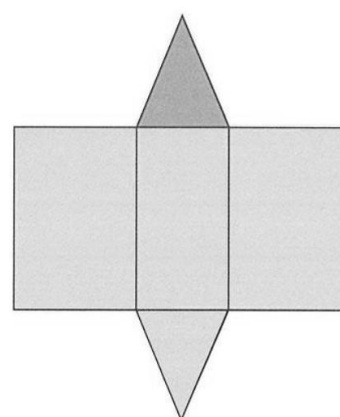


Total surface area:
 = 132 cm^2

e



Area of front and back:
 $\left(\frac{10 \times 12}{2}\right) \times 2$
 Area of left side:
 20×13
 Area of right side:
 20×13
 Area of bottom:
 10×20



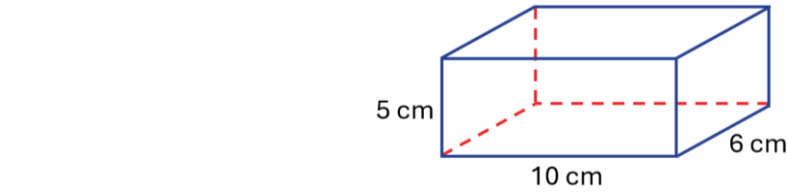
Total surface area:
 = 840 cm^2

SURFACE AREA OF A RECTANGULAR PRISM WITHOUT A NET

- To find **surface area**, picture the faces covering the 3D shape.

Example Calculate surface area of a rectangular prism without a net.

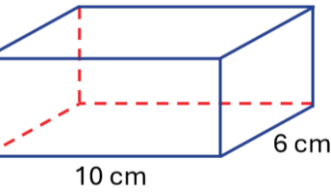
Calculate the surface area of this rectangular prism.



front and back rectangles

$$(10 \times 5) \times 2$$

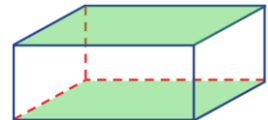
$$= 100$$



side rectangles

$$(5 \times 6) \times 2$$

$$= 60$$



top and bottom rectangles

$$(10 \times 6) \times 2$$

$$= 120$$

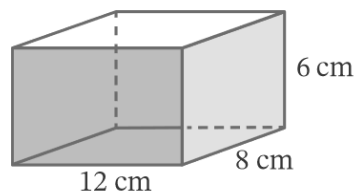
$$\text{Total surface area} = 100 + 60 + 120$$

$$= 280 \text{ cm}^2$$

Why do you think this “visualising” method is recommended over the “net” method?

It is faster because we don't need to draw a

Calculate the surface area of this rectangular prism.



front and back rectangles

side rectangles

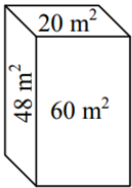
top and bottom rectangles

Total surface area:

432 cm²

1 Find the surface area of these solids.

a



Area of front and back

Area of sides

Area of top and bottom

Total surface area

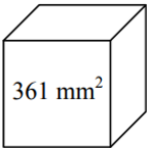
60×2

48×2

20×2

256 m^2

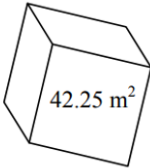
b



361 mm^2

2166 m^2

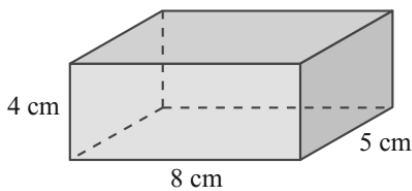
c



42.25 m^2

253.5 m^2

2 Complete the following the calculate the surface area of the rectangular prism.



Area of front and back = $(8 \times \dots) \times 2 = \dots \text{ cm}^2$

Area of both sides = $(\dots \times \dots) \times 2 = \dots \text{ cm}^2$

Area of top and bottom = $(\dots \times \dots) \times 2 = \dots \text{ cm}^2$

Total surface area = $\dots + \dots + \dots = \dots \text{ cm}^2$

$(8 \times 4) \times 2$

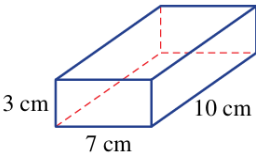
$(5 \times 4) \times 2$

$(8 \times 5) \times 2$

184 cm^2

3 Find the surface area of the following prisms.

a



3 cm

7 cm

10 cm

Front and back:

Sides:

Top and bottom:

Total surface area

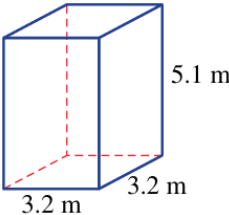
$(7 \times 3) \times 2$

$(3 \times 10) \times 2$

$(7 \times 10) \times 2$

242 cm^2

b



5.1 m

3.2 m

3.2 m

Front and back:

Sides:

Top and bottom:

Total surface area:

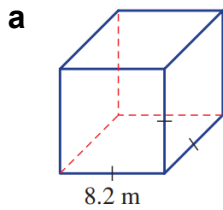
$(3.2 \times 5.1) \times 2$

$(3.2 \times 5.1) \times 2$

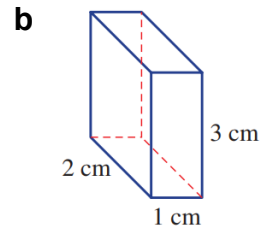
$(3.2 \times 3.2) \times 2$

85.76 m^2

- 4 Find the surface area of the following prisms.

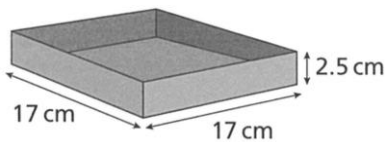


403.4 cm²



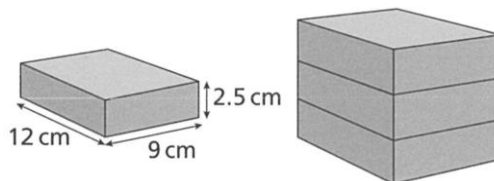
22 cm²

- 5 Beca makes an open box. She is going to paint the outside of the box. Work out the total area to be painted.



459 cm²

- 6 Ed stacks three identical rectangular prisms on top of each other as shown.



He says "The surface area of my shape will be three times as large as the surface area of one of the rectangular prisms."

Explain why he is wrong.

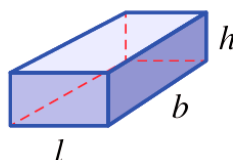
When you stack the prisms, two faces are no longer on the surface, so the surface area will be less.

- 7 A book measuring 20 cm long, 15 cm wide and 3 cm thick is covered in plastic. What area of plastic is needed to cover 1000 books? Convert your answer to m².

SA of 1 book: 810 cm²

SA of 1000 books: $810\,000\text{ cm}^2 \div 100^2 = 81\text{ m}^2$

- 8 Consider the rectangular prism shown.



- a Write an expression for the surface area of the prism.

$$SA = 2lb + 2lh + 2bh$$

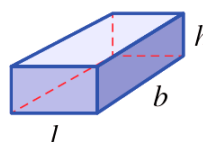
- b By factorising, show that the formula for the surface area for any rectangular prism is $SA = 2(lb + lh + bh)$.

Factorise out common factor of 2 from expression in part a.

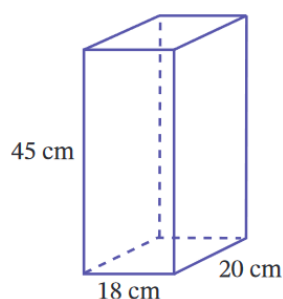
- 9 Use this formula to quickly calculate the surface area of these rectangular prisms.

Surface Area of a Rectangular Prism

$$SA = 2(lb + lh + bh)$$

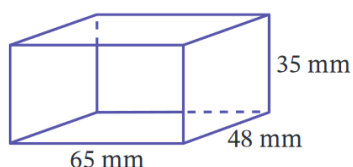


a



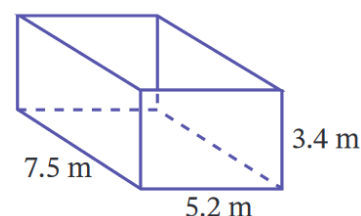
$$4140 \text{ cm}^2$$

b



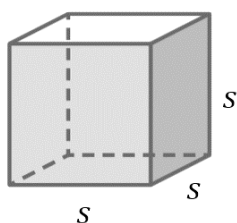
$$14\,150 \text{ mm}^2$$

c



$$164.36 \text{ m}^2$$

- 10 What would be the formula for the surface area of a cube with side length s ?



$$6s^2$$

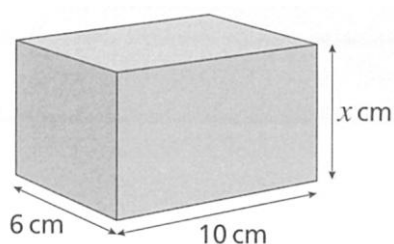
- 11** A rectangular prism storage crate measures 0.8 m by 1 m by 1.5 m.
 Claudia paints all the faces of the crate.
 One tin of paint costs \$8. Each tin covers 4 m²
 Work out the total cost of the paint that Claudia needs.

$$\text{Surface area} = 7 \text{ m}^2$$

$$2 \text{ paint tins needed}$$

$$\$8 \times 2 = \$16$$

- 12** The surface area of this rectangular prism is 376 cm². Work out the value of x .

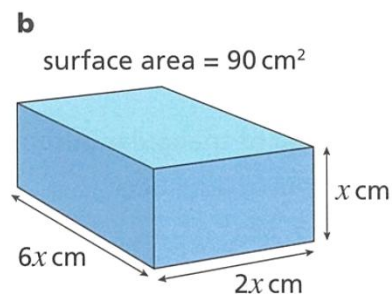
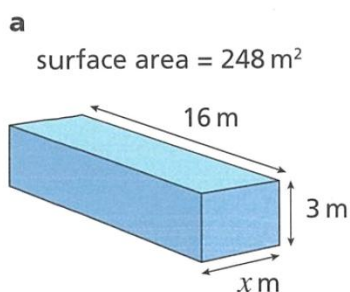


$$376 = 2(60 + 6x + 10x)$$

$$188 = 60 + 16x$$

$$x = 8 \text{ cm}$$

Work out the value of x in each of these rectangular prisms.



$$4 \text{ m}$$

$$1.5 \text{ cm}$$

- 13** A cube has surface area 150 m². Determine the length of each side of the cube.

$$150 = 6x^2$$

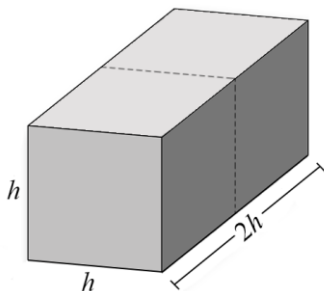
$$x^2 = 25$$

$$x = 5 \text{ m}$$

14 NAPLAN A+

The rectangular prism, shown below, is cut in half to form 2 equal cubes.

What is the ratio of the surface area of the rectangular prism to one of the cubes?



$$\text{SA of 1 cube} = 6h^2$$

$$\text{SA of prism} = 2(h^2 + 2h^2 + 2h^2) = 10h^2$$

$$\begin{aligned} \text{Ratio of prism to cube} &= 10h^2 : 6h^2 \\ &= 5 : 3 \end{aligned}$$

15 A rectangular prism has dimensions in the ratio 1:3:5. It has a volume of 120 cm^3 . Find:

a the dimensions of the prism.

$$\text{Let sides be } x, 3x, 5x$$

$$V = Ah$$

$$120 = 15x^3$$

$$x = 2$$

$$\text{Dimensions are } 2 \text{ cm, } 6 \text{ cm, } 10 \text{ cm}$$

b the surface area of the prism.

$$SA = 2(2 \times 6 + 2 \times 10 + 6 \times 10)$$

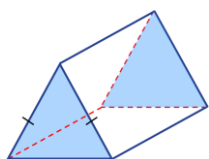
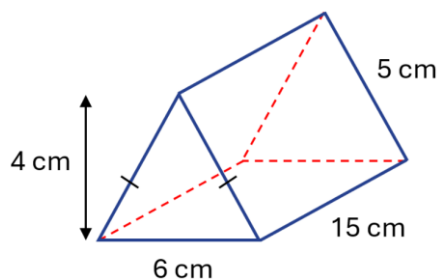
$$= 184 \text{ cm}^2$$

SURFACE AREA OF A TRIANGULAR PRISM WITHOUT A NET

- To find **surface area**, picture the faces covering the 3D shape.

Example Calculate surface area of a triangular prism without a net.

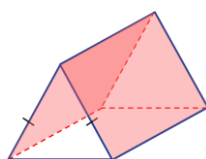
Calculate the surface area of this prism.



front and back triangles

$$\left(\frac{6 \times 4}{2}\right) \times 2$$

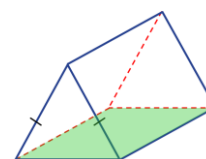
$$= 24$$



side rectangles

$$(15 \times 5) \times 2$$

$$= 150$$



bottom rectangle

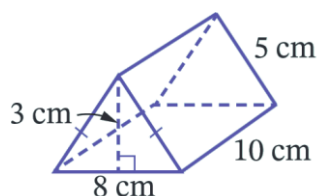
$$6 \times 15$$

$$= 90$$

$$\text{Total surface area} = 24 + 150 + 90$$

$$= 264 \text{ cm}^2$$

Calculate the surface area of this triangular prism.



front and back triangles

side rectangles

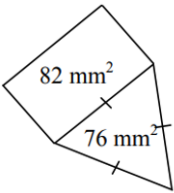
bottom rectangle

Total surface area:

204 cm²

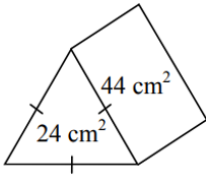
1 Calculate the surface area of these triangular prisms.

a



398 mm²

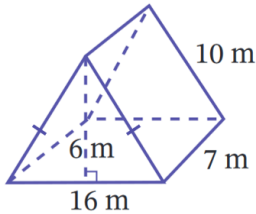
b



180 cm²

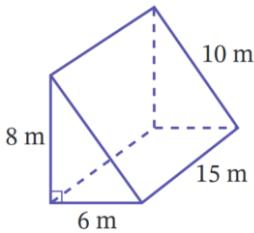
2 Calculate the surface area of these triangular prisms.

a



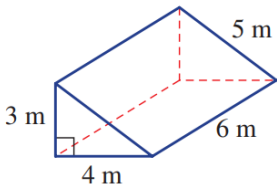
Area of front and back: $\left(\frac{16 \times 6}{2}\right) \times 2$
Area of sides: 7×10
Area of bottom: 7×16
Total surface area: 348 cm²

b



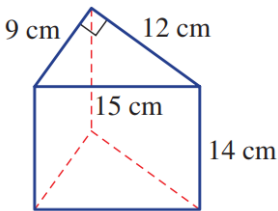
Area of front and back: $\left(\frac{6 \times 8}{2}\right) \times 2$
Area of left side: 15×8
Area of right side: 15×10
Area of bottom: 15×6
Total surface area: 408 cm²

c



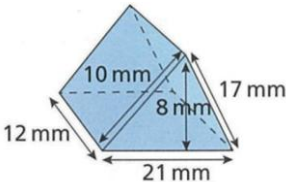
84 m²

d



612 cm²

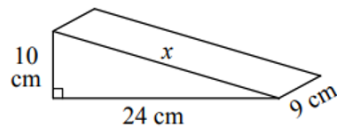
3 Find the surface area of the triangular prism.



744 mm²

- 4 Calculate the missing length using Pythagoras' Theorem, then calculate the surface area.

a



$$x^2 = \boxed{}^2 + \boxed{}^2$$

$$x^2 = \boxed{}$$

$$x = \sqrt{\boxed{}}$$

$$x = \boxed{} \text{ cm}$$

$$SA = 2 \times \frac{1}{2} \times \boxed{} \times \boxed{}$$

$$+ \boxed{} \times 9$$

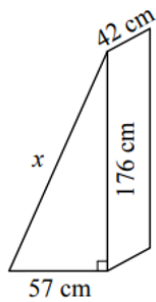
$$+ \boxed{} \times 9$$

$$+ \boxed{} \times 9$$

$$SA = \boxed{} \text{ cm}^2$$

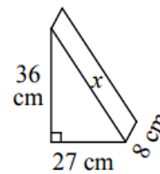
$$x = 26 \text{ cm}, SA = 780 \text{ cm}^2$$

b



$$x = 185 \text{ cm}, SA = 27\,588 \text{ cm}^2$$

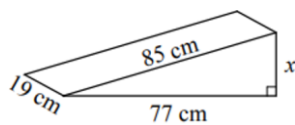
c



$$x = 45 \text{ cm}, SA = 1836 \text{ cm}^2$$

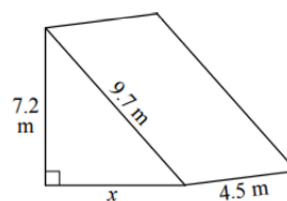
For these triangles, you are finding a shorter side, not the hypotenuse.
Calculate the surface area.

d



$$x = 36 \text{ cm}, SA = 6534 \text{ cm}^2$$

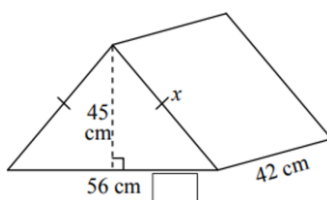
e



$$x = 6.5 \text{ cm}, SA = 152.1 \text{ m}^2$$

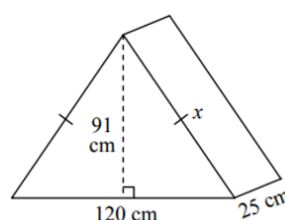
Halve the base, then find the missing length.
Calculate the surface area.

f



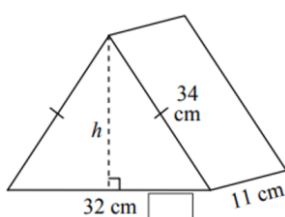
$$x = 53 \text{ cm}, SA = 9324 \text{ cm}^2$$

g



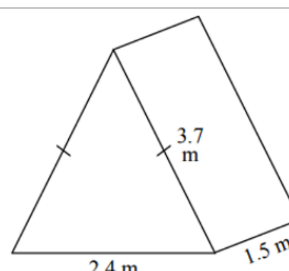
$$x = 109 \text{ cm}, SA = 19\,370 \text{ cm}^2$$

h



$$h = 30 \text{ cm}, SA = 2060 \text{ cm}^2$$

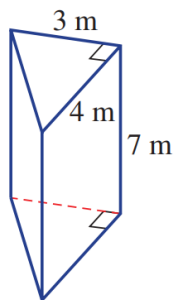
i



$$h = 3.5 \text{ m}, SA = 23.1 \text{ m}^2$$

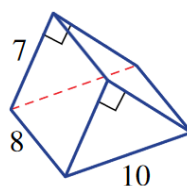
- 5 Use Pythagoras' Theorem $h^2 = a^2 + b^2$ to find unknown lengths and hence calculate the surface area of these solids. Round to 1 d.p. where necessary.

a

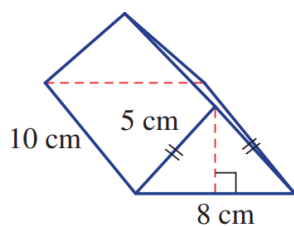


b

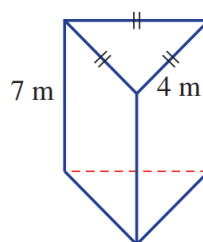
All units in cm.



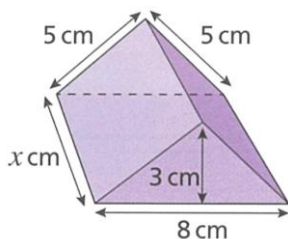
c



d



- 6 This prism has surface area 222 cm^2 . Determine the value of x .



$$\left(\frac{3 \times 8}{2}\right) \times 2 + 5x + 5x + 8x = 222$$

$$18x = 198$$

$$x = 11 \text{ cm}$$