YEAR 10

Mathematics

STUDENT COMPANION

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Pearson Secondary Teaching Hub Maths 10

Student Companion

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We pay our respects to Elders, past and present.

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How to use this Student Companion

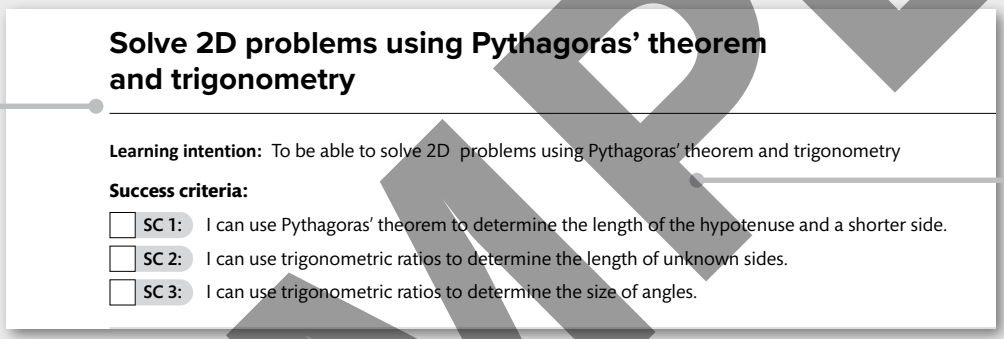
The Student Companion is a complementary resource that offers a print medium for corresponding lessons in Pearson Secondary Teaching Hub. It is designed to support teaching and learning by providing learners with a place to create a portfolio of learning to suit their individual needs, whether you are:

- supporting a blended classroom using the strengths of print and digital
- preparing for exams by creating a study guide or bound reference
- needing a tool to differentiate learning or
- looking for meaningful homework tasks.

Learners can develop their portfolio of learning as part of classroom learning or at home as an additional opportunity to engage and re-engage with the knowledge and skills from the lesson.

This could be done as prior learning in a flipped classroom environment or as an additional revision or homework task.

Learning intention and success criteria



Solve 2D problems using Pythagoras' theorem and trigonometry

Learning intention: To be able to solve 2D problems using Pythagoras' theorem and trigonometry

Success criteria:

- ☐ **SC 1:** I can use Pythagoras' theorem to determine the length of the hypotenuse and a shorter side.
- ☐ **SC 2:** I can use trigonometric ratios to determine the length of unknown sides.
- ☐ **SC 3:** I can use trigonometric ratios to determine the size of angles.

Learning intentions are provided for every lesson. The learning intentions are goals or objectives that align to the corresponding digital lesson. They describe what learners should know, understand or be able to do by the end of the lesson.

Success criteria clarify expectations and describe what success looks like. The success criteria are specific, concrete and measurable so learners can actively engage with and reflect on their evidence of learning within each lesson.

Worked examples

Worked examples provide learners with a step-by-step solution to a problem. The worked examples in the Student Companion correspond to those in the digital lesson and are provided for each skill to:

- scaffold learning
- support skill acquisition
- reduce the cognitive load.

The **worked examples** are an effective tool to demonstrate what success looks like. The 'try yourself' format of the worked examples in the Student Companion support the gradual release of responsibility. Learners can view a completed worked example and a video walkthrough of the worked example in the corresponding digital lesson and then apply the scaffolded steps themselves to solve a unique problem.

Practice questions are provided in the student companion so that learners can apply the knowledge and skills obtained in the worked example given. These questions are designed to ensure learners build confidence and demonstrate efficiency. They follow on from the Check your understanding questions beside the corresponding worked example in the digital lesson.

Each lesson in the Student Companion contains a space for students to reflect on their understanding. The simple and intuitive design of the **lesson reflection tool** allows students to scale their confidence, reflect on their learning and identify areas in which they need support.

Solve 3D problems using Pythagoras' theorem

Learning intention: To be able to solve 3D problems using Pythagoras' theorem

Success criteria:

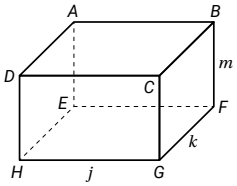
- ☐ **SC 1:** I can identify triangles in 3D shapes.
- ☐ **SC 2:** I can use Pythagoras' theorem to determine unknown side lengths in 3D shapes.

SC 1: I can identify triangles in 3D shapes

Worked example: Identifying right angled triangles on a rectangular prism

The rectangular prism $ABCDEFGH$ has known dimensions j, k and m.

Draw each of the named right-angled triangles in 2D, writing the known side lengths where possible, and assigning letters where sides are different lengths from those given.



(a) ΔABF

Thinking	Working
Identify the right angle. Identify the known lengths. Orient the triangle as closely as possible to the 3D diagram. Mark the unknown side as x.	

(b) ΔAFG

Thinking	Working
Identify the right angle. Identify the known lengths. Orient the triangle as closely as possible to the 3D diagram, but now facing the page. Mark the unknown side as y.	

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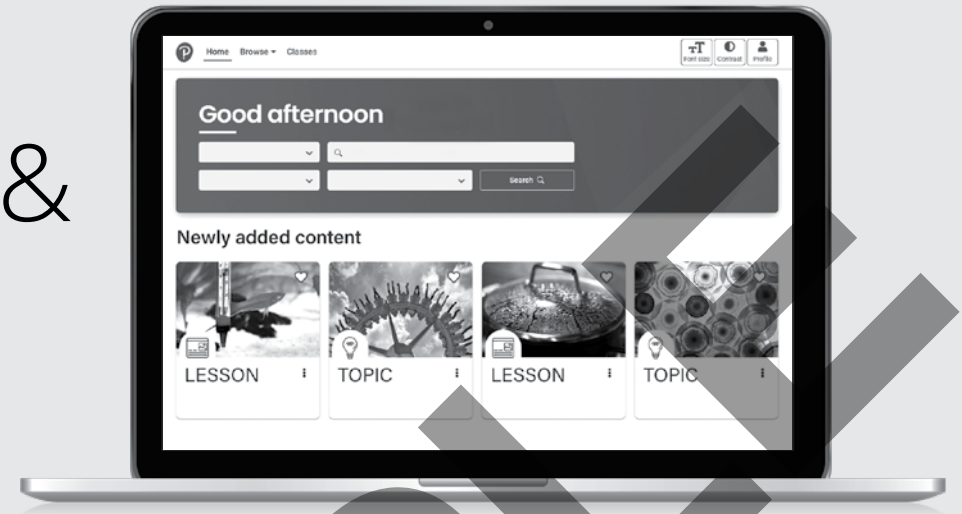

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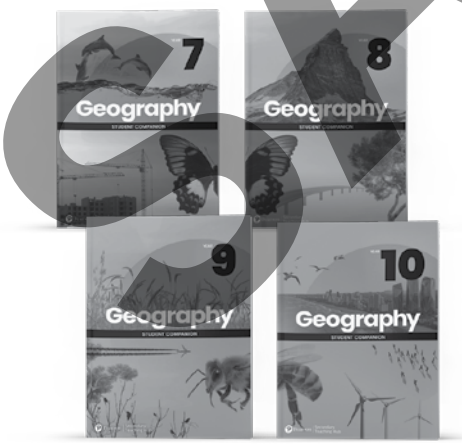
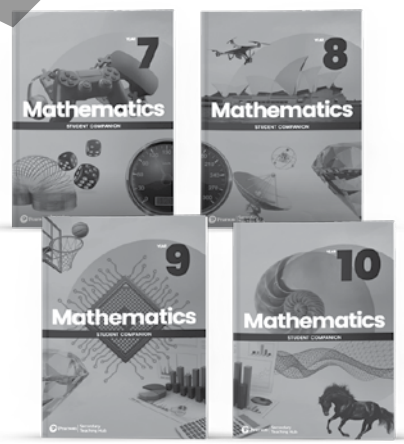
Pearson Secondary Teaching Hub has been designed to simplify teaching and energise learning across multiple subjects. Every *Secondary Teaching Hub* subject offers best-practice learning design delivered in flexible formats for the modern classroom, plus uniquely developed content structures and features for each subject.

This solution provides continuity for students from one class to the next and a rare whole-school view for school leadership while still delivering the rigour and support teachers need to help students meet the specific outcomes of their curriculum area.

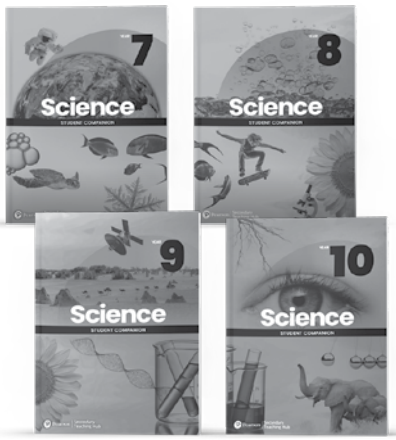
Geography



Mathematics



Science



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Draw and describe the surface of right prisms and cylinders

Learning intention: To be able to draw and describe the surface of right prisms and cylinders

Success criteria:

- ☐ **SC 1:** I can draw the nets of right prisms and cylinders.
- ☐ **SC 2:** I can describe the surface of right prisms and cylinders.
- ☐ **SC 3:** I can estimate the surface area of objects using right prisms and cylinders.

SC 1: I can draw the nets of right prisms and cylinders

Worked example: Drawing nets of prisms and cylinders

Draw a net for each of the following. Label it with the dimensions.

(a) A triangular prism of height 5 cm with the sides of the triangle 2 cm, 3 cm and 4 cm, respectively

Thinking	Working
Sketch the prism, marking the given dimensions.	
Draw a row of rectangles with the height the same as the height of the prism and with lengths to match the dimensions of the triangular cross-section. Add the triangles forming the cross-sections, matching the attached sides and ensuring that the other lengths will fold to matching edges. Label the net with the dimensions.	

(b) A cylinder of height 6 cm and diameter 8 cm

Thinking	Working
Sketch the cylinder, marking the given dimensions.	
Determine the dimensions of the rectangle forming the curved section.	
Draw the rectangle that would form the curved section. Add a circle on the two lengths of the rectangle, placed at any point along the edge that would curve around each circle. Label the net with the dimensions.	

1 Draw and label the net of a triangular prism of height 6 cm and a triangular base with the dimensions given.

(a) 4 cm, 4 cm, 3 cm

(b) 3 cm, 4 cm, 5 cm

2 Draw and label the net of a cylinder with:

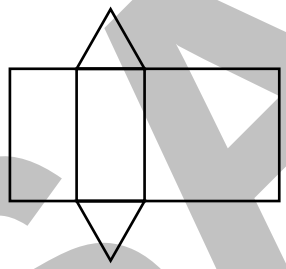
(a) Height: 5 cm; diameter: 5 cm

(b) Height: 5 cm; diameter: 4 cm

3 Each of the nets below includes an error.

Describe the smallest possible change to each diagram so that it becomes the net of a prism.

(a)



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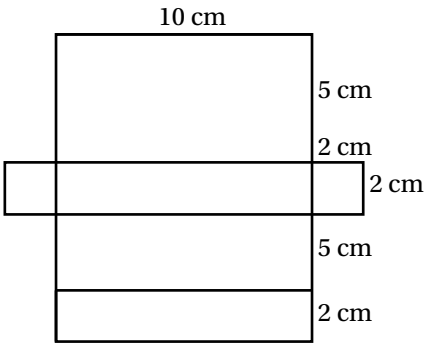

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SC 2: I can describe the surface of right prisms and cylinders

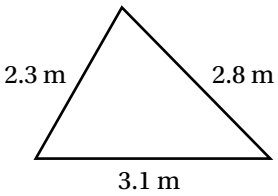
Worked example: Describing the surface of prisms and cylinders

Describe the surface and give the dimensions of each of a cylinder of radius 6 cm and height 5 cm.

Thinking	Working
Account for the base and top of the prism.	
The length of the circumference of the circle needs to be calculated to determine the dimensions of the rectangle that the curved surface can be imagined to be unwrapped to form.	
Give the dimensions of the rectangle forming the curved surface.	

1 Describe the dimensions of the surface of each prism of height 3 m and these bases.

(a)



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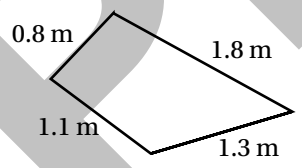

2 Describe the dimensions of the surface of each prism of height 10 cm and bases with these dimensions:

(a) an isosceles triangle with one side of 11 cm and two sides of 9 cm

(b) a quadrilateral with three sides of 8 cm and one side of 15 cm

3 Describe the dimensions of the surface of each cylinder of radius 3 cm and these heights:

(a) 6 cm

(b) 9 cm

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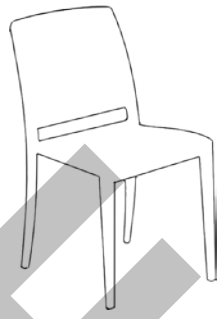
SC 3: I can estimate the surface area of objects using right prisms and cylinders

Worked example: Estimating the surface area of a solid

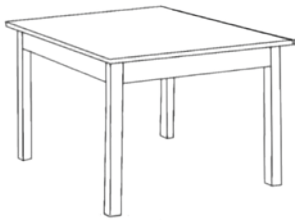


A plastic chair stands 1.1 m high.

Estimate the surface area of the chair, explaining your method and qualifying the results.

Thinking	Working
Approximate the surfaces of the chair seat and back as rectangles and estimate their dimensions.	
Calculate the total area of both sides of the surfaces of the chair seat and back.	
Approximate the surfaces of the chair legs as cylinders and estimate their dimensions.	
Calculate the total area of the curved surfaces (rounding to whole numbers).	
Calculate the total of the main areas. Then round the answer as appropriate to give an estimate. (Two significant figures is as accurate as you can be in many circumstances.)	
Qualify the result with some ways to improve the estimate.	

1 The wooden square-based table below has dimensions 120 cm by 120 cm by 80 cm. It has horizontal bracing between the legs to make it strong.



(a) By estimating the thickness of the top to be 5 cm and the width of the square legs to be 10 cm, estimate the surface area of the table. Ignore any parts other than the top and legs.

(b) Explain what could be done to improve the estimate.

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Calculate the surface area of prisms and cylinders

Learning intention: To be able to calculate the surface area of prisms and cylinders

Success criteria:

- ☐ **SC 1:** I can calculate the surface area of a cylinder.
- ☐ **SC 2:** I can calculate the surface area of a cylinder in exact form.
- ☐ **SC 3:** I can calculate the surface area of a prism.

SC 1: I can calculate the surface area of a cylinder

Worked example: Calculating the surface area of a cylinder

Calculate, correct to 2 decimal places, the surface area of a cylinder of height 12 cm and radius 5 cm.

Thinking	Working
Write a suitable formula and identify the substitutions.	
Substitute and calculate the value. Write the answer, rounding as instructed and including units of area.	

1 Calculate, correct to 2 decimal places, the surface area of the cylinders with these dimensions.

(a) $h = 15$ cm, $r = 3$ cm

(b) $h = 6$ m, $r = 5$ m

(c) $h = 21.4$ cm, $r = 10.5$ cm

(d) $h = 35$ mm, $r = 47$ mm

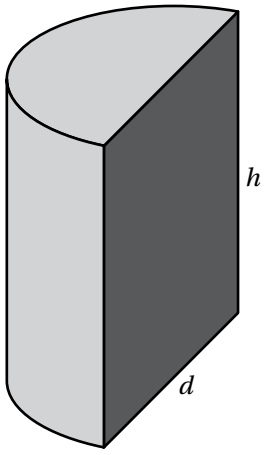
(e) $h = 15$ m, $d = 8$ m

(f) $h = 7$ cm, $d = 10$ cm

(g) $h = 96$ mm, $d = 68$ mm

(h) $h = 2.95$ m, $d = 3.54$ m

2 A solid half-cylinder is shown.



(a) Write a formula to calculate the surface area of the half-cylinder in terms of d, h and r.

(b) Calculate, correct to 2 decimal places, the surface area of the half-cylinders with these dimensions.

(i) $h = 9$ cm, $d = 7$ cm

(ii) $h = 4.8$ m, $d = 3.4$ m

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SC 2: I can calculate the surface area of a cylinder in exact form

Worked example: Calculating the surface area of a cylinder in terms of pi

Calculate the surface area of a cylinder of diameter 12 cm and height 5 cm in terms of π.

Thinking	Working
Write a suitable formula and identify the substitutions.	
Substitute and calculate the exact value, treating π as an algebraic symbol.	

1 Calculate the surface area of the cylinders with these dimensions.

Give your answers in terms of π.

(a) $h = 10$ m, $d = 4$ m

(b) $h = 15$ cm, $d = 18$ cm

(c) $h = 48$ mm, $d = 62$ mm

(d) $h = 9.6$ cm, $d = 6.5$ cm

(e) $h = 6$ cm, $r = 4$ cm

(f) $h = 3$ m, $r = 1$ m

(g) $h = 3.6$ cm, $r = 5.5$ cm

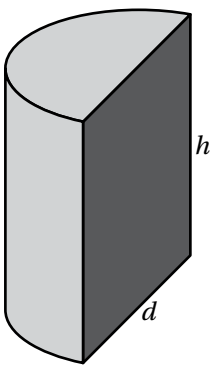
(h) $h = 58$ mm, $r = 45$ mm

2 A solid half-cylinder is shown.

Calculate the surface area of the half-cylinders with these dimensions.
Give your answers in terms of π.

(a) $h = 15$ cm, $d = 20$ cm

(b) $h = 1.5$ m, $d = 2.48$ m



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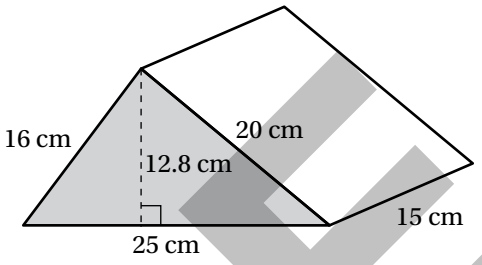
SC 3: I can calculate the surface area of a prism

Worked example: Calculating the surface area of a prism

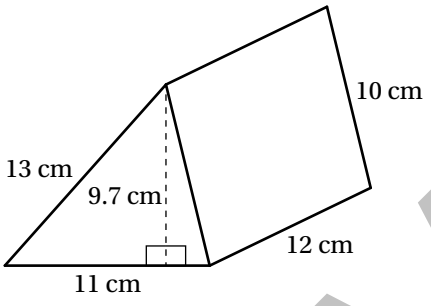
Calculate the surface area of the prism.

Thinking	Working
Calculate the area of the triangle forming the cross-section of the prism.	
Calculate the surface area using: SA = 2(area of cross-section) + perimeter of cross-section × height of prism	



1 Calculate the surface area of these prisms. Give your answers to the nearest whole number.

(a)



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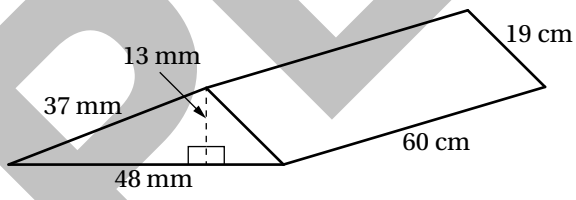

2 Determine the surface area of each of the following right-angled-triangle-based prisms of height 24 cm, given two of the three side lengths of the triangular ends.

(a) Sides forming the right angle: 50 cm, 120 cm **(b)** Shortest side: 11 cm; longest side: 61 cm

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Determine the surface area of a composite solid

Learning intention: To be able to determine the surface area of a composite solid

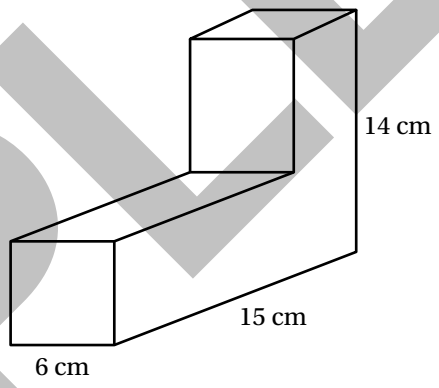
Success criteria:

- ☐ **SC 1:** I can determine the surface area of a composite solid made from prisms.
- ☐ **SC 2:** I can determine the surface area of a composite solid.

SC 1: I can determine the surface area of a composite solid made from prisms.

Worked example: Calculating the surface area of a solid made from two prisms

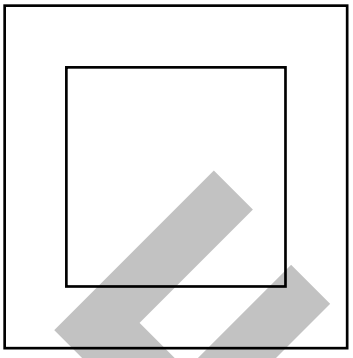
Determine the surface area of this composite solid made by joining two rectangular prisms.



Thinking	Working
Determine any unknown lengths of edges that are needed for the calculations.	
Calculate the area of the L-shape forming the cross-section first.	
Calculate the surface area by adding the areas of the two L-shapes and the two squares and four different rectangles. (Alternatively, use the general method for a prism.)	
Check your answer by adding the surface area of each rectangular prism and subtracting twice the area of the join.	

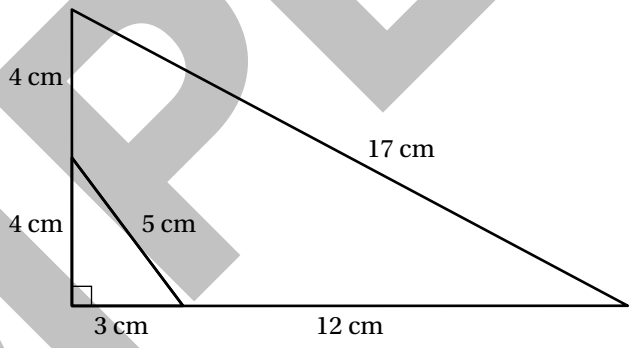
1 Determine the surface area of these solids made from two prisms, as described.

(a) A square-based prism 8 cm × 8 cm × 5 cm is joined to a larger square-based prism 16 cm × 16 cm × 12 cm with one of the smaller squares placed in the middle of one of the larger squares, as shown in the plan view.



(b) A rectangular prism 4 m × 5 m × 7 m is joined to another rectangular prism 5.5 m × 6.3 m × 1 m with a 4 m × 5 m face placed in one corner of a 5.5 m × 6.3 m face.

(c) A pair of right-angled-triangle-based prisms, each of height 12 cm, are joined with the right angles aligned, as shown in the plan view.



2 A square-based wooden block 60 cm × 60 cm × 3 cm has three 15 cm × 15 cm square holes punched through from top to bottom.

(a) Calculate the surface area of the original prism.

(b) Determine the surface area of the eventual shape.

3 A rectangular tabletop 1.8 m × 1.1 m × 3 cm, has six legs attached, each 10 cm × 10 cm × 75 cm.

Determine the surface area of the table in both square metres and square centimetres.

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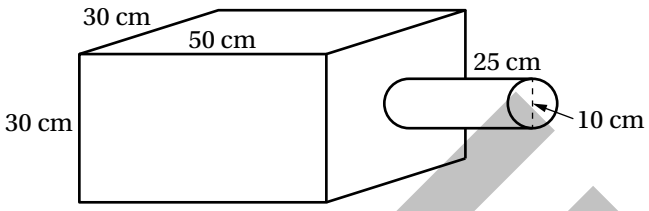
SC 2: I can determine the surface area of a composite solid

Worked example: Calculating the surface area of a composite solid

A symmetrical solid is made from a cylinder of diameter 10 cm attached to a square-based prism, as shown.

Determine the surface area of the solid.

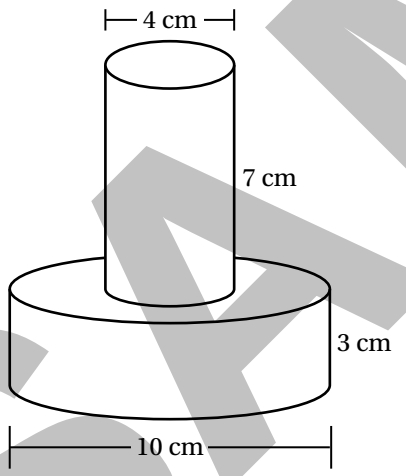
Give your answer in terms of π and then round correct to the nearest whole number.



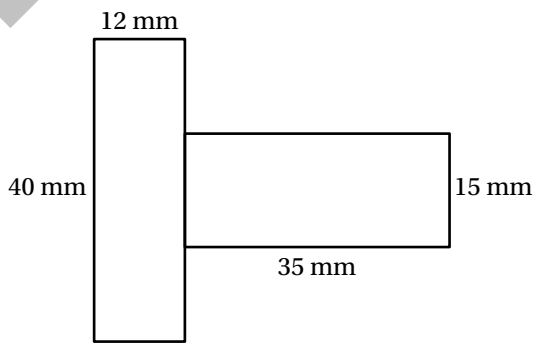
Thinking	Working
Decide on a strategy for the calculation, justifying any combined areas.	
Determine any unknown lengths that are needed for the calculation.	
Calculate the surface area following your strategy. Give your answer as required, including units of area.	

1 Determine the surface area of each composite solid in terms of π and then round correct to the nearest whole number.

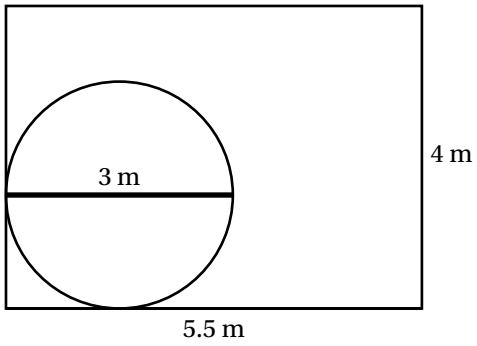
(a) Two cylinders are attached to form a symmetrical solid.



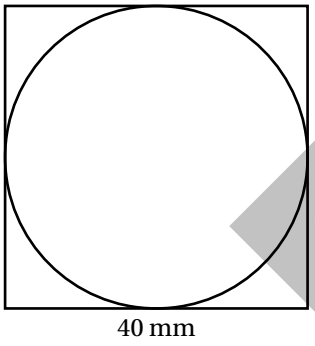
(b) A cylinder is attached to the middle of another cylinder to form a symmetrical solid. The side view is shown.



(c) A cylinder is attached to a rectangular prism as shown in the plan view.
The heights of the cylinder and the prism are both 0.8 m.



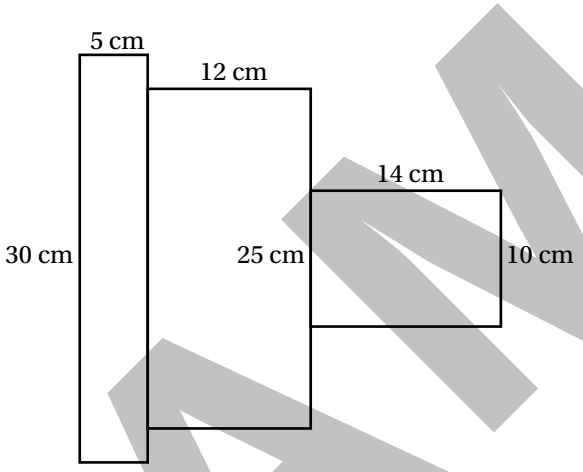
(d) A cylinder is attached to a square-based prism as shown in the plan view.
The height of the cylinder is 8 cm and the height of the prism is 15 cm.



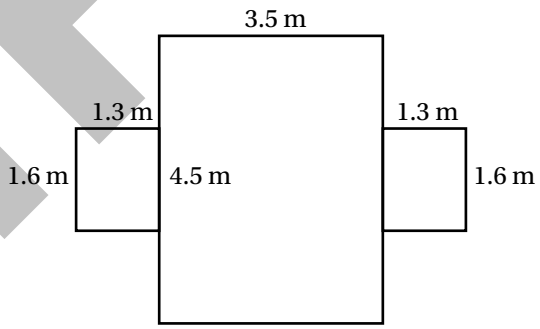
2 The side views are given of symmetrical solids showing three cylinders joined at their flat surfaces.

Determine the surface area of each solid in terms of π, and then round correct to the nearest whole number.

(a)



(b)



3 A circular tabletop of diameter 1.6 m and depth 2 cm has a cylindrical hole of diameter 6 cm cut through at the centre to allow an umbrella to be inserted.

Determine its surface area in square centimetres, correct to the nearest whole number, and then in square metres, correct to 2 decimal places.

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Calculate volume and capacity

Learning intention: To be able to calculate volume and capacity

Success criteria:

- ☐ **SC 1:** I can understand the connection between volume and capacity.
- ☐ **SC 2:** I can describe the cross-section of prisms and cylinders.
- ☐ **SC 3:** I can calculate volume and capacity in practical situations.

SC 1: I can understand the connection between volume and capacity

Worked example: Connecting volume and capacity

Calculate the volume of pourable substance that each of the rectangular prisms can contain, given the internal dimensions. Convert the results to appropriate units of capacity.

(a) 20 cm × 26 cm × 1 m

Thinking	Working
Identify the dimension/s with units that are different from the others. Convert the units.	
Calculate the volume using $V = lwh$.	
Convert to units of capacity using 1 mL = 1 cm^3 and where appropriate 1 L = 1000 mL.	

(b) 55 m × 32 m × 6 m

Thinking	Working
Calculate the volume using $V = lwh$.	
Convert to units of capacity using 1 kL = 1 m^3 and where appropriate 1 ML = 1000 kL.	

1 Calculate the volume of pourable substance that each of the rectangular prisms can contain, given the internal dimensions. Convert the results to appropriate units of capacity.

(a) 14 cm × 11 cm × 6 cm **(b)** 1.8 m × 70 cm × 35 cm **(c)** 4 m × 8 m × 5 m

(d) 40 m × 35 m × 10 m **(e)** 42 m × 24 m × 25 m **(f)** 3.6 m × 3.6 m × 4.2 m

2 Determine the number of buckets of water needed to fill a fish tank 45.6 cm × 28.5 cm × 32.7 cm if 5 L of water is carried in the bucket each time.

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SC 2: I can describe the cross-section of prisms and cylinders

Worked example: Identifying the consistent cross-section of a prism or cylinder

(a) Describe the cross-section of a cylinder of height 60 cm and diameter 50 cm.

Thinking	Working
Describe the circular base since it is the same as the cross-section.	

(b) Describe the cross-section of a triangular prism of height 2.4 m and a base with sides 1.2 m, 1.5 m and 1.3 m.

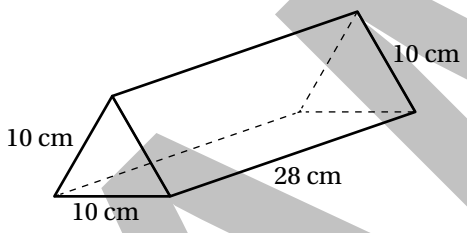
Thinking	Working
Describe the triangular base since it is the same as the cross-section.	

1 Describe the cross-section of each of these cylinders.

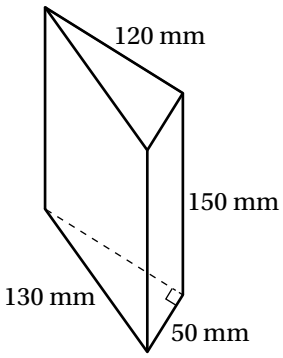
(a) Height 5 cm, diameter 12 cm **(b)** Height 3 m, diameter 95 cm **(c)** Height 42 mm, radius 64 mm

2 Draw or shade the cross-section of each of these prisms. Make assumptions about symmetry as necessary.

(a)



(b)



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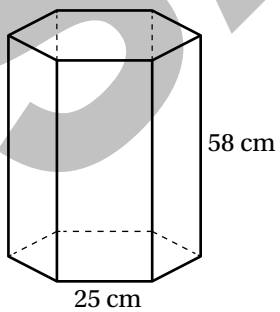
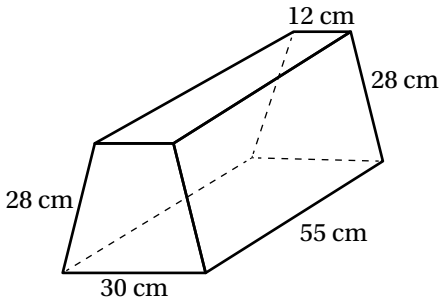


(d)



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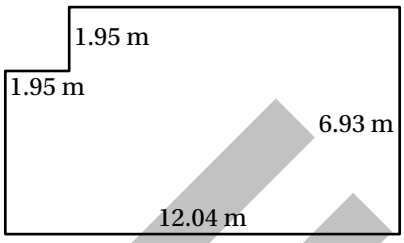
SC 3: I can calculate volume and capacity in practical situations

Worked example: Estimating rainfall from a roof

Estimate the amount of water that will collect in a tank when 12 mm of rain falls on the house with the footprint shown. Write your answer in litres or kilolitres, correct to 2 significant figures.

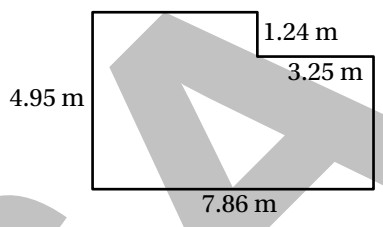


Thinking	Working
List the assumptions you have to make.	
Calculate the area of the footprint of the house in square metres.	
Use $V = A_{\text{cross section}} \times h$ to calculate the volume of a prism with the same cross-section as the footprint of the house and height equal to the rainfall. Ensure all the units match. Convert to units of capacity, rounding as required.	
Write the answer in words.	

1 Estimate the amount of water (in litres or kilolitres, correct to 2 significant figures) that collects in a tank when 25 mm of rain falls on a house with the following footprints. State any assumptions you had to make.

Assumptions: _____

(a)



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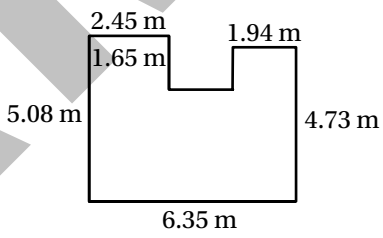

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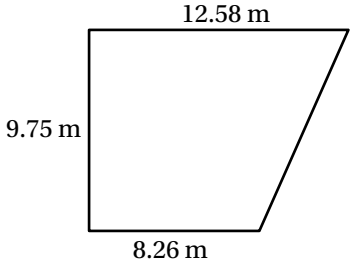

2 Ten marbles are dropped into a measuring jug containing 70.0 mL of water.

(a) If the water level rises to 81.5 mL, determine the volume of a marble in cubic centimetres, correct to 1 decimal place.

(b) If 10 cubes of edge length 13 mm had been dropped into the water instead of the marbles, calculate the level the water would have risen to, to the nearest 0.5 mL.

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Determine the volume of cylinders and prisms

Learning intention: I can calculate the volume of cylinders and prisms

Success criteria:

- ☐ **SC 1:** I can calculate the volume and capacity of a cylinder.
- ☐ **SC 2:** I can calculate the volume of a prism.
- ☐ **SC 3:** I can determine the volume of composite solids made from prisms and cylinders.

SC 1: I can calculate the volume and capacity of a cylinder

Worked example: Calculating the volume and capacity of a cylinder

(a) Calculate the volume of a cylinder of height 2.8 m and radius 70 cm, in terms of π.

Thinking	Working
Recall the formula for the volume of a cylinder.	
Identify the given information (converting to the same units where necessary).	
Substitute and calculate the value.	

(b) Calculate, in litres (to 2 decimal places), the capacity of a cylinder of height 35 cm and diameter 40 cm.

Thinking	Working
Recall the formula for the volume of a cylinder.	
Identify the given information (converting to the same units where necessary).	
Substitute and calculate the value.	
Convert the volume in cubic centimetres to millilitres and then to litres, rounding as instructed.	

1 Calculate the volume and capacity, correct to 2 decimal places, of these cylinders.

(a) $h = 14$ cm, $r = 5$ cm **(b)** $h = 1.5$ m, $r = 2$ m **(c)** $h = 34.8$ cm, $r = 15$ cm

(d) $h = 26$ m, $d = 8$ m **(e)** $h = 8$ cm, $d = 11$ cm **(f)** $h = 8.5$ mm, $d = 3$ cm

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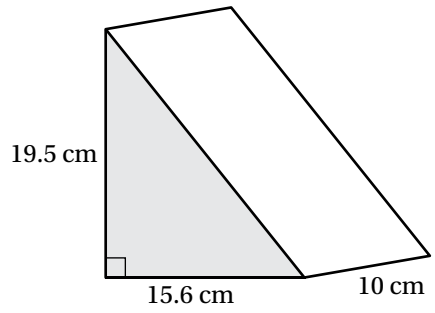
SC 2: I can calculate the volume of a prism

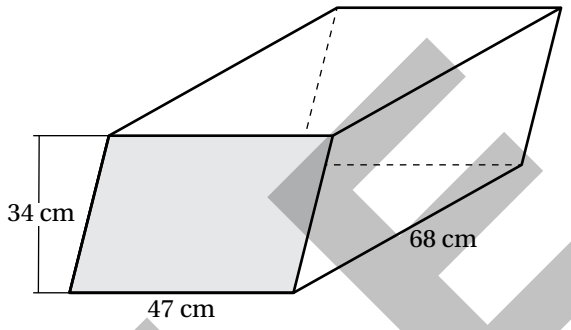
Worked example: Calculating the volume of a prism

Calculate the volume of these prisms.

(a)



(b)

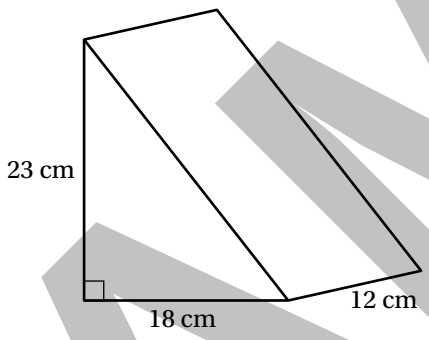


(a)

Thinking	**Working**	
Write a formula for volume for the specific shape of the cross-section. Identify the given information.	**(a)**	**(b)**
Substitute and calculate the volume.		

1 Calculate the exact volume of these triangular prisms. Give your answer in surd form if necessary.

(a)



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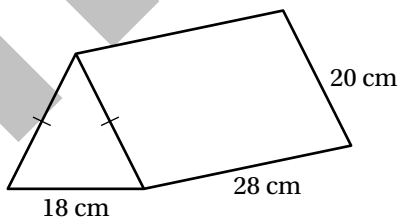
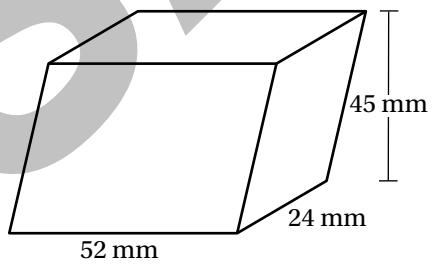
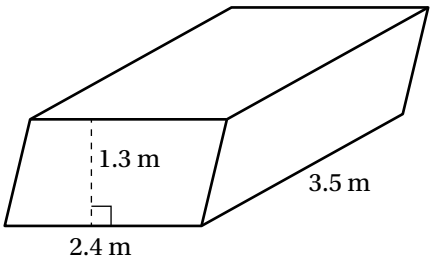


2 Calculate the volume of these parallelogram-based prisms.

(a)



(b)



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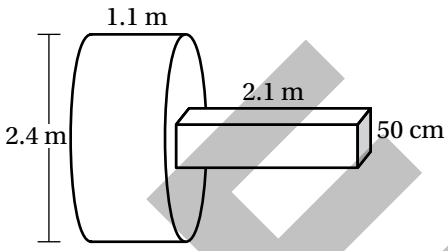
SC 3: I can determine the volume of composite solids made from prisms and cylinders

Worked example: Calculating the volume of solids made from prisms and cylinders

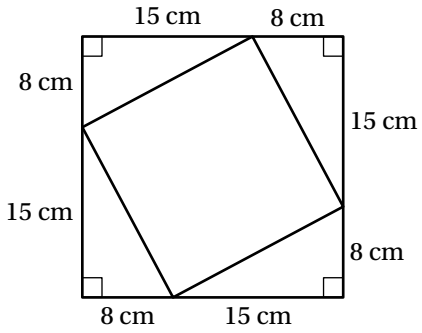
(a) A square-based prism is attached to a cylinder of diameter 2.4 m, as shown.

Calculate the volume of the composite solid.
Give your answer in cubic metres, in terms of π and then round correct to 1 decimal place.



Thinking	Working
Write a formula for the total volume of the composite solid. Identify the given information (converting to metres where necessary).	
Substitute and calculate the volume in terms of π and then round as instructed.	

(b) A square-based prism of height 30 cm has had indents of four right-angled triangles made in the top, to a depth of 5 cm. This top-down view shows the shape of the indents.
Calculate the volume of the composite solid.



Thinking	Working
Write a formula for the remaining volume of the original prism. Identify the given information.	
Substitute and calculate.	

1 Determine the volume of these composite solids made from two prisms, as described.

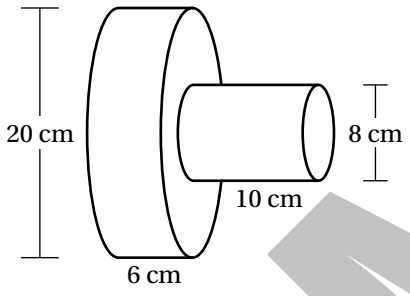
(a) A square-based prism 20 cm × 20 cm × 16 cm joined to a larger square-based prism 30 cm × 30 cm × 25 cm.

(b) A rectangular prism 2.2 m × 1.9 m × 1.8 m joined to another rectangular prism 4.8 m × 3.5 m × 2 m.

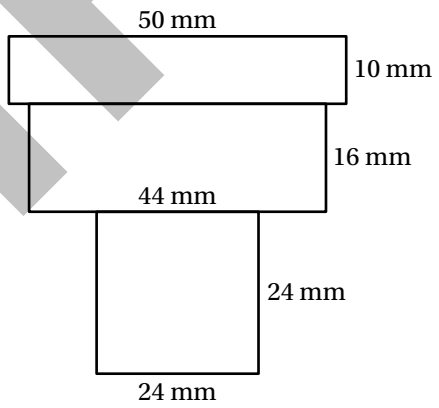
(c) A pair of right-angled triangle-based prisms, each of height 8 cm, where the perpendicular sides of the triangular base of the first prism are 5.2 cm and 5.5 cm and of the second prism are 8.4 cm and 8.7 cm.

2 Determine the volume of these composite solids in terms of π and then round correct to the nearest whole number.

(a)



(b) Three cylinders are joined as shown in the side view.



(c) A cylinder of diameter 1.4 m and height 1 m is attached to a rectangular prism 2 m × 1.5 m × 3 m.

3 A rectangular tabletop 2.1 m × 1.2 m × 4 cm, has six legs attached, each 7 cm × 7 cm × 78 cm.

Determine the volume of the table in both cubic metres and cubic centimetres.

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