Y LENGTH, AREA AND VOLUME

- **9A** Understanding length
- **9B** Perimeter
- **9C** Understanding area
- **9D** Area of a rectangle

- **9E** Area of a parallelogram
- **9F** Area of a triangle
- **96** Surface area
- **9H** Volume and capacity

ESSENTIAL QUESTION

What is the same and what is different about measuring two-dimensional shapes and three-dimensional objects?



Are you ready?



463

9A Understanding length

Start thinking!

Length can be measured in millimetres (mm), centimetres (cm), metres (m) or kilometres (km).

- 1 Look around the room. Find an object that has a length dimension (length, width or height) of 1 mm.
- **2** Look for an object that has a length of 1 cm and another that has a length of 1 m. Visualising these unit lengths will help you estimate the length of things.

b How many millimetres are equivalent to 1 m?

- 3 Look at your ruler. How many millimetres are equivalent to 1 cm?
- յ՝ Դունով որ իսկաների ու իսկանիս կունում իսկանիս հանդեմ կունում հանությունների 4 Look at a tape measure or metre ruler. **a** How many centimetres are equivalent to 1 m?
- 5 How many metres are equivalent to 1 km? (Think about the prefix 'kilo'. What does 'kilo' mean?)
- 6 Complete these statements.
 - **b** cm = 1 m**a** _____ mm = 1 cm \mathbf{c} m = 1 km
- 7 Discuss with a partner how to convert a length measurement from centimetres to millimetres. How is this different from converting millimetres to centimetres? Would this method work for other units?
- 8 Explain how to convert a length measurement to: **a** a smaller unit **b** a larger unit.

KEY IDEAS

- ▶ Metric units of length are millimetres (mm), centimetres (cm), metres (m) and kilometres (km).
- ► If you start by estimating a length, you can decide whether your length measurement is reasonable.
- A unit of length can be converted to another unit of length by multiplying or dividing by the conversion factor.
- Multiply by the conversion factor to convert to a smaller unit.
- Divide by the conversion factor to convert to a larger unit.



EXERCISE 9A Understanding length

 1 Estimate the length of each line segment. a b c 2 Use a ruler to accurately measure the length of each line segment in question 1. 3 Complete each statement by using the words <i>multiply</i> or <i>divide</i>. a When converting a length measurement to a smaller unit, you need to by the conversion factor. b When converting a length measurement to a larger unit, you need to by the conversion factor. 				
EXAMPLE 9A-1 Converting units of length Complete these length conversions. m a 5.4 km =m b 900 mm =cm				
 THINK a Multiply by 1000 as you are converting to a smaller unit. (1 km = 1000 m.) b Divide by 10 as you are converting to a larger unit. (10 mm = 1 cm.) 	WRITE a 5.4 km = (5.4 × 1000) m = 5400 m b 900 mm = (900 ÷ 10) cm = 90 cm			
4 Complete these length statements. a $8 \text{ km} = \underline{\qquad} \text{m}$ b c $700 \text{ mm} = \underline{\qquad} \text{cm}$ d e $16 \text{ cm} = \underline{\qquad} \text{mm}$ f	$3 m = \ cm$ $500 cm = \ m$ $2000 m = \ km$			

- **g** $3.5 \text{ m} = ___ \text{ cm}$
- **i** 1.34 km = ____ m
- **k** 84 m = ____ km
- **m** 0.06 km = ____ m
- 7.9 mm = ____ cm

- **h** 9 mm = ____ cm
- **j** 0.47 cm = $_$ mm
- $1 51.2 \text{ cm} = ___ \text{m}$
- **n** 3.8 m = ____ cm
- **p** 4310 mm = _____ km



UNDERSTANDING AND FLUENCY





a Choose something in your classroom such as a desk, table, chair or the floor.
 Use an appropriate instrument to take length measurements. Draw a diagram and show all the measurements you found. Remember to include the unit you used.

- **b** Choose something outside in the school grounds that could be measured in metres or perhaps kilometres. Again, measure it using an appropriate instrument. Draw a diagram and show all the measurements you found, including the units.
- c Show your results for parts **a** and **b** to a classmate. Explain your choice of measuring instrument and length unit used. Were these the best choices?
- **21** a Estimate the length of this connecting cord, excluding the connectors.
 - b Describe how you could accurately measure the length of the cord from the photo. What equipment could you use?
 - c Find the length of the cord. Compare your result to the estimate you made in part **a**.

a

e

22 Estimate the length of each of these. Then use string or cotton and a ruler to measure their length.

b

d

Reflect

How do you decide which instrument and unit to use when measuring length?

9B Perimeter

Start thinking!

The course for a charity walk is shown. The walkers start and finish at the same place.



- 1 What is the distance from the start to the:
 - a first checkpoint? b second checkpoint?
 - c third checkpoint? d fourth checkpoint?
- 2 Calculate the total distance around the course from start to finish. Explain how you worked this out.
- 3 Compare your answer to question 2 with that of some classmates. Explain why they may be different.
- 4 The total distance around the course from start to finish is also called the **perimeter** of the course. Why are the distances you calculated in question 1 not considered to be the perimeter?

KEY IDEAS

- Perimeter is the distance around the outside edge of a **two-dimensional** (2D) shape.
- Since perimeter is a length measurement, common units are millimetres, centimetres, metres and kilometres.
- To calculate the perimeter, add the length of each side together.
- ► All length measurements must be in the same unit before being added.

EXERCISE 9B Perimeter



UNDERSTANDING AND FLUENCY



4 Find the perimeter of each shape by using a ruler to measure each side to the nearest millimetre.



2 Calculate the perimeter of these shapes, which are shown on 1-cm grid paper.





6 Find the lengths of all the sides and then calculate the perimeter of each shape.

10 For each shape in question **9**, write a formula for the perimeter using *l* to represent the length of a side.

UNDERSTANDING AND FLUENCY

- **11** In baseball, a batter must run from the batting plate to first base, then second base, third base and finally home. Use the measurements shown to answer the following.
 - a How far does a batter run to reach first base after hitting the ball?
 - b How far does a batter run to reach third base after hitting the ball?
 - c How far does a batter run to reach the home plate when scoring a home run?
 - d Which one out of parts **a**, **b** and **c** is the same as the perimeter of the baseball diamond?



- **12** A volleyball court is 18 m long and 9 m wide.
 - a Draw a diagram of the court showing its measurements and the net.
 - **b** Calculate its perimeter.
 - c To warm up, each team jogs five laps around their half of the court. That is, the players jog along the outside lines and along the net on their side of the court. How far does a player jog during the warm-up?
- 13 The photo shown has a perimeter of 52 cm.What is the width of the photo?
- 14 A square drink coaster has a perimeter of 342 mm. What is the length of the drink coaster?
- **15** A gardener plans to dig a rectangular herb garden with a border 36 m long. List five sets of possible dimensions for the herb garden.
- 16 A Hills hoist clothesline has four lines arranged in squares. Use the measurements shown on the diagram (looking at the clothesline from above) to calculate the total length of line used.
- 17 A rectangular swimming pool of length 7.5 m and width 4.6 m is to have a safety fence built around it. If the fence will be 2 m from the edge of the pool, calculate the total length of fencing needed (include the gate).







Reflect



9C Understanding area

Start thinking!

The amount of space enclosed by the outside edge of a 2D shape is called the **area**.

Common units used for area are square millimetres (mm²), square centimetres (cm²), square metres (m²) and square kilometres (km²).

- 1 Predict which item has the larger area: the postage stamp or the 50-cent coin.
- 2 The outline of the stamp is traced on to 1-cm grid paper.
 - **a** What is the area of the stamp in square centimetres?
 - **b** How did you work this out?
- **3** The outline of a 50-cent coin is traced on to 1-cm grid paper.
 - **a** What is the area of the coin in square centimetres?
 - **b** How did you work this out?
- 4 Did you find an exact or approximate value for the area of the coin? Give a reason.
- 5 Which has the larger area: the stamp or the coin? Was your prediction correct?

KEY IDEAS

- Area is the amount of space enclosed by a 2D shape.
- Common units of area are square millimetres (mm²), square centimetres (cm²), square metres (m²) and square kilometres (km²).
- ► The area of a shape can be found by counting the number of whole square units covered by the shape as well as any half square units covered.
- For an irregular shape, the area can be approximated by counting all the square units that are covered and all the square units that are *at least* half covered by the shape.



this square this square is counted

- area of 1 cm²

A square with side length 1 cm has area 1 cm².

EXERCISE 9C Understanding area





UNDERSTANDING AND FLUENCY



- a Find the area of each shape.
- **b** Find the perimeter of each shape.
- c Explain the difference between finding the area and finding the perimeter of each shape.

EXAMPLE 9C-2

Estimating area

Estimate the area of this shape drawn on 1-cm grid paper.

тнілк

- 1 Some squares are not totally enclosed in the shape. Count the squares that are completely enclosed and those that are at least half covered by the shape. Tick the squares to be counted.
- 2 Count the number of squares that are ticked and write your answer for the area. To show your answer is approximate, use the symbol ≈, which means 'is approximately equal to'.









3 Estimate the area of each shape drawn on 1-cm grid paper.

- **4** Work with a partner to answer these questions.
 - **a i** Draw a square that has an area of 1 mm².
 - ii Give two examples where area would best be measured in mm².
 - **b i** Draw a square that has an area of 1 cm^2 .
 - ii Give two examples where area would best be measured in cm².
 - **c i** Use some sheets of newspaper, scissors and sticky tape to make a square that has an area of 1 m².
 - ii Give two examples of situations where area would best be measured in m².
 - i Describe the size of 1 km².
 - ii Give two examples of situations where area would best be measured in km².
- 5 Use your answers to question 4 to estimate the area of these.
 - a top of your desk

ď

- **b** front cover of your textbook
- c one wall of your classroom
- d surface of your thumb nail
- e sole of your shoe
- f floor of your classroom



6 Find the area covered by each of these (shown actual size). A 1-cm grid has been placed over each photo.



- a basketball court
- c national park
- e surface of a skateboard ramp
- **b** wristwatch face
- d five-dollar note
- **f** family-size pizza
- 8 Another unit of area is the hectare (ha). This unit is often used for land area. One hectare has the area of a square with side lengths of 100 m. That is, 1 ha = $10\ 000\ m^2$ or $100\ ha = 1\ km^2$.
 - **a** A dairy farm covers an area of 8 km². What is the area of the farm in hectares?
 - b A 40-ha property is advertised for sale. What is the land area of the property in m²?



- 9 A grid has been placed over a map of Australia where each square in the grid covers 250 000 km².
 - a Find the approximate area of Australia in km².
 - **b** Express the area of Australia in hectares.
 - c The official area of Australia (including islands) is 7 692 024 km². Compare your approximation with this. Explain why the values are different and suggest how you could improve the accuracy of your approximation.



- **10** Explain why there are situations where you can find the exact area and others where you can only find the approximate area. Provide examples to support your answer.
- **11** Use the 1-cm grid to estimate the area of this cartoon character.



Reflect

What is the difference between measuring length and measuring area?

9D Area of a rectangle

Start thinking!

- 1 Using 1-cm grid paper, draw three different rectangles. In each case make the measurements for the length and width a whole number of centimetres.
- 2 Copy and complete this table.

Rectangle	Length (cm)	Width (cm)	Area (cm²)
1			
2			
3			

- 3 Describe a shortcut you could use to calculate the area of each rectangle without counting the squares in the grid.
- 4 Use the words length, width and area to write a rule for calculating the area of a rectangle.
- 5 When would this rule be more useful than counting the squares in a grid?

KEY IDEAS

- ► Rule for area of a rectangle: Area = length × width
- Instead of using words, pronumerals can be used to write a formula for calculating the area of any rectangle.
- ► Formula for area (A) of a rectangle, where l represents the length measurement and w represents the width measurement:
 A = l × w (or A = lw)

l	
	w

• The measurements for *l* and *w* must be in the same unit before substituting them into the formula.

EXERCISE 9D Area of a rectangle



- **2** Find the area of the rectangles with these dimensions.
 - a length 9 cm, width 7 cm
- **b** length 13 mm, width 4 mm
- c length 6 m, width 1 m
- d length 10.4 cm, width 5 cm
- e length 14.2 mm, width 9.7 mm





UNDERSTANDING AND FLUENCY

3 Calculate the area of each rectangle.



4 Find the area of each rectangle with these dimensions.

- a length 3 m, width 100 cm
- c length 4 km, width 280 m
- e length 3.1 cm, width 20 mm
- **b** length 8 cm, width 50 mm
- d length 600 mm, width 30 cm
- f length 8.4 cm, width 0.05 m



10 Find the area of each shape in question **9**.

11 In questions 9 and 10, the shapes are divided into separate rectangles and the area of each rectangle added together to find the total area of the shape. Explain how you could calculate the area of the shaded region in this shape using subtraction instead. What is the area?



12 Find the area of the shaded region in each of these.



13 Find i the area and ii the perimeter of each shape.



- 14 Write three sets of possible dimensions for rectangles with these areas.
 a 48 cm²
 b 15 m²
- 15 How many sets of possible dimensions are there for a square that has an area of 16 mm²? List the possibilities.



- vi the area of the court that a player can serve the tennis ball into
- **b** When it starts to rain, a waterproof cover is placed over the playing surface. Suggest how a cover or covers could be designed to be quickly and effectively used.
- c Draw a diagram with the dimensions labelled to show how the court could be covered.
- **d** What amount of waterproof material would be required for the cover?

75 mm

- 17 What is the width of the screen of this iPhone (shown at near right), if its area is 3750 mm²?
- 18 If the area of the screen on the BlackBerry phone (shown at far right) is 3000 mm², what is its length?
- **19** The perimeter of a rectangle with a length of 14 cm is 46 cm. What is its area?



- **20** The perimeter of a square is 80 m. What is its area?
- **21** The perimeter of a rectangle is 64 cm. What is its area? Explain how you worked out your answer.
- 22 To mark out the boundary of a new vegetable garden, I have been given a piece of string 12 m long. List the dimensions of five possible rectangular vegetable gardens I could make. Which of these five would have the largest area?
- 23 Does a rectangle exist where the perimeter has the same value (measured in cm) as the area (measured in cm²)? Explain your answer.

Reflect

How would you explain to a friend the difference between the area and the perimeter of a rectangle?

net

9E Area of a parallelogram

Start thinking!

A **parallelogram** is a four-sided shape with two pairs of parallel sides and opposite sides equal in length. The dimensions **base** and **height** are always at right angles to each other.



KEY IDEAS

- ► Rule for area of a parallelogram: Area = base × height
- Formula for area (A) of a parallelogram, where
 b represents the base length and h represents the height:
 A = b × h (or A = bh)



- The base and height are perpendicular (at right angles) to each other.
- ► The measurements for *b* and *h* must be in the same unit before substituting into the formula.

EXERCISE 9E Area of a parallelogram



2 Calculate the area of each parallelogram in question **1**.

- **3** Find the area of each parallelogram with these dimensions.
 - **a** base length 5 cm, height 3 cm
- **b** base length 10 mm, height 17 mm
- c base length 4 m, height 1.5 m d base length 2.5 cm, height 4.1 cm

UNDERSTANDING AND FLUENCY



4 Calculate the area of each parallelogram in cm^2 .



- **5** Find the area of each parallelogram with these dimensions.
 - **a** base length 30 mm, height 5 cm
 - b base length 58 m, height 200 cm
 - c base length 0.06 m, height 40 mm
 - d base length 27.4 cm, height 27.4 mm





- **10** Use the measurements shown on this photo of floor tiles to calculate the area of a red tile.
- 27cm 13.5 cm
- **11** A stair rail is supported by five identical sections of glass panels.
 - a Use the dimensions shown in the photo to calculate the area of glass needed for all sections.
 - **b** If the glass was to be 10 cm higher in each panel, what area of glass would be needed?



12 A badge for a jacket is made by sewing three pieces of fabric as shown. The centre piece is in the shape of a parallelogram and the other two pieces are rectangles.



- a What area of fabric is needed for the parallelogram?
- **b** What area of fabric is needed for each rectangle?
- c Calculate the total area of fabric needed for this badge.
- **d** Black cord is sewn around the outer edge of the badge to make it stand out on the jacket. Calculate how much black cord is needed.
- 13 Write three sets of possible dimensions for parallelograms with these areas.
 a 24 cm²
 b 14 mm²
- 14 The area of a parallelogram is 20 cm^2 . If the height is 4 cm, how long is the base?
- **15** The area of a parallelogram is 36 cm^2 . If the base is 45 mm long, what is the height?

16 The perimeter of the **rhombus** shown is 40 cm.

- a Explain how the area of the rhombus could be calculated. Do you have enough information to calculate the area?
- **b** Would the area of the rhombus be larger or smaller than 100 cm²? Explain your answer.
- **17** Consider the rectangle shown.
 - a Calculate its area using the formula for the area of a rectangle $(A = l \times w)$.
 - **b** Calculate its area using the formula for the area of a parallelogram $(A = b \times h)$.
- 15 cm
- c Explain why you obtain the same answer in each case.
- 18 The marble-tiled floor of the church of San Giorgio Maggiore in Venice, Italy (completed in 1610) is made up of just two different 2D shapes. When you walk over the floor you experience the optical illusion of viewing three-dimensional (3D) objects.



- a What are the two shapes used for the tiles?
- What 3D object appears in the photo at right as a result of the optical illusion?
 Use the dimensions shown in the photo for question 10 to calculate the area of the three tiles (black, red, white) that make up the illusion of one 3D object.
- **19** While walking along a street, you notice that the shape of the green arrow in a traffic light is formed using a rectangle and two parallelograms. Estimate the area of the green arrow in the traffic light shown below using the length measurement provided.



Reflect

Explain why there is a connection between the area of a parallelogram and the area of a rectangle.

PROBLEM SOLVING AND REASONING

9F Area of a triangle

Start thinking!

A triangle has three sides. The dimensions base and height are always at right angles to each other.



The area of a triangle can be compared to the area of a parallelogram or rectangle (as a rectangle is a type of parallelogram).

1 Copy each parallelogram shown below. A triangle has been formed inside each shape.



- 2 Label the base and the height on each diagram.
- 3 How does the area of the triangle compare to the parallelogram in each case?
- 4 If the rule for the area of a parallelogram is base × height, write a rule for the area of a triangle.

KEY IDEAS

- Rule for area of a triangle: Area = $\frac{1}{2} \times \text{base} \times \text{height}$
- Formula for area (A) of a triangle, where b represents the base measurement and h represents the height:
 A = ¹/₂ × b × h (or A = ¹/₂bh)



- The base and height must be perpendicular to each other.
- The measurements for *b* and *h* must be in the same unit before substituting into the formula.

EXERCISE 9F Area of a triangle



- **2** Calculate the area of each triangle in question **1**.
- **3** Find the area of the triangles with these dimensions.
 - a base 12 cm, height 9 cm
 - b base 24 mm, height 4 mm
 - c base 5 m, height 3 m
 - d base 8.6 cm, height 7 cm
 - e base 14.2 mm, height 9.7 mm
 - f base 17.03 m, height 15.4 m

UNDERSTANDING AND FLUENCY

4 a Draw diagrams of three different triangles where the base measurement is 10 cm and the height measurement is 6 cm.

- **b** Calculate the area of each triangle.
- **5** Calculate the area of metal required for each sign.



EXAMPLE 9F-2 Calculating area of a triangle after converting units Calculate the area of this triangle. 95 cm 4.8 m WRITE THINK $A = \frac{1}{2} \times b \times h$ 1 Identify the shape (triangle). Write the formula for the area of a triangle. 2 Identify the measurements for *b* and *h*. Check that b = 4.8 mthey are both in the same units (no). Convert h to h = 95 cm = 0.95 mmetres. $A = \frac{1}{2} \times 4.8 \text{ m} \times 0.95 \text{ m}$ 3 Substitute the values for *b* and *h* into the formula. $= 2.28 \text{ m}^2$ 4 Calculate the result and include the appropriate unit.









UNDERSTANDING AND FLUENCY

14 Write three sets of possible dimensions for triangles with these areas.

a 32 cm^2 **b** 40 m^2

15 The area of a triangle is 20 cm^2 . If the base is 10 cm long, what is the height?

¹⁶ If the total area that has been enamelled on these earrings is 270 mm², calculate how wide each earring is at the top.



17 Use your understanding of how to find the area of a triangle to calculate the area of metal needed for each of these signs.



18 Estimate the total area of fabric needed to make the sail used by this windsurfer.



Reflect

What is important to remember about the base and height of a triangle?

9G Surface area

Start thinking!

The **surface area** of a 3D object is the total area of its surface. Drawing a **net** of the object helps us to identify the shapes that make up the surface.

For example, the **rectangular prism** and its net can be drawn for this tissue box.

- 1 How many faces does the rectangular prism have?
- 2 Explain how the net of the prism can help you work out the surface area.

KEY IDEAS

- The surface area of a 3D object is the total area of the outer surface of the object.
- The surface area of a prism is the sum of the areas of each face of the prism.
- A rectangular prism has six faces. There are three pairs of identical faces.
- Drawing the net of a prism can help you see all the faces of the prism and allow you to calculate the surface area more easily.



EXERCISE 9G Surface area



UNDERSTANDING AND FLUENCY



2 Calculate the surface area of each rectangular prism.





0.8 m

1.5 m

2.2 m

- **10** A cube has a surface area of 150 cm^2 . What is the side length of the cube?
- 11 A sculpture shaped as a cube has a surface area of 24 m². What are the dimensions of the sculpture?
- **12** The outside walls and the roof of the dog kennel are to be painted.
 - a Calculate the area of the kennel to be painted (in m²).
 - **b** If a small can of paint covers 8 m², how many cans of paint will be needed?



1.8 m

13 Another sculpture is constructed in the shape of a rectangular box with a smaller box placed on top. The dimensions of the boxes are shown in the diagram. To finish the sculpture, the artist must work out the surface area to be painted and hence how much paint is needed. Calculate the surface area of the sculpture. (Ignore the surface sitting on the ground as the viewing public will not see this.)

viewing public will not see this.) 2.6 m

14 These objects are made of 1-cm blocks. Work out their surface area (including the



Reflect

Explain how area can still relate to 3D objects as well as 2D shapes.

9H Volume and capacity

Start thinking!

Besides surface area, other measurements that relate to 3D objects are **volume** and **capacity**. The volume of a 3D object is the amount of space it occupies.

Common units used for volume are cubic millimetres (mm³), cubic centimetres (cm³) and cubic metres (m³). Cubic units are used since the standard units of volume are based on cubes.

A cube with a side length of 1 cm has a volume of 1 cm^3 .

- 1 Describe the dimensions of a cube that would represent:
 - **a** a cubic centimetre **b** a cubic metre **c** a cubic millimetre.
- 2 This rectangular prism is made up of 40 cubes (two layers of 20 cubes). As each cube has a volume of 1 cm³, the volume of the prism is 40 cm³.
 - a How many cubes are in one layer? b How many layers are there?
 - **c** Use your answers to parts **a** and **b** to work out the volume of the prism.
 - **d** What is the length, width and height of the prism?
 - e We can use a shortcut to calculate the volume. If the base of the prism has an area of length × width, show how you can use the shortcut of multiplying the base area by the height to find the volume of this prism.

KEY IDEAS

- Volume is the amount of space that a 3D object occupies.
- Common units of volume are cubic millimetres (mm³), cubic centimetres (cm³) and cubic metres (m³).

Rule:

- Volume of any prism
- Formula: $V = A \times h$ (or V = Ah)

Formula: $V = l \times w \times h$ (or V = lwh)

volume = base area \times height

=length \times width \times height

► Volume of a rectangular prism Rule: volume = base area × height



- ▶ The measurements for *l*, *w* and *h* must be in the same unit before substituting into the formula.
- Capacity is the amount of fluid that a container can hold.
- Common units of capacity are millilitres (mL), litres (L), kilolitres (kL) and megalitres (ML).





h

A

EXERCISE 9H Volume and capacity





2 m







- **a** 8 L = mL1000 $\times 1000$ × 1000 **b** 15 kL = _____L MI kL L **c** 70 mL = L mL d 6.4 ML = ____ kL ÷ 1000 ÷ 1000 ÷ 1000 2500 L = kL e 3 kL = mL
- **10** The units of volume and capacity are related. A container with an inside volume of 1 cm³ holds 1 mL of liquid. This means that a container with an inside volume of 1000 cm³ holds 1 L and a container with an inside volume of 1 m³ holds 1 kL.

f

Copy and complete the table by working out the missing value for each container.

11 Soil has been dug from a garden to form a rectangular hole of length 5 m, width 2 m and depth 50 cm. How many cubic metres of soil have been removed?

	Inside volume of container	Capacity of container
a	14 cm ³	mL
b	cm ³	3 L
2	5.8 m ³	kL
ł	750 cm ³	L
e	m ³	1000 kL
f	m ³	6.4 ML

12 A delivery of 3 m^3 of concrete is to be spread to form a driveway that is 7.5 m long and 3.2 m wide. How thick will the layer of concrete be?

- **13** A sugar cube has the dimensions 1 cm by 1 cm by 1 cm.
 - a Explain what 1 cm by 1 cm by 1 cm means.
 - **b** What is the volume of one sugar cube?
 - c How many sugar cubes would fit into a box with dimensions 12 cm by 10 cm by 7 cm?
 - **d** Describe the dimensions of a box that could exactly fit 1000 sugar cubes in it. Is there more than one answer? Explain.
 - e Give five possible sets of dimensions for a box that could exactly fit 240 sugar cubes in it.
 - **f** How many sets of dimensions are possible for the smallest box that could fit 20 sugar cubes? List them.
- **14** Consider this container of juice.
 - a Calculate the volume of the container.
 - **b** Use your answer to part **a** to calculate the capacity of the container.
 - c Is the capacity of juice shown on the labelling of the container the same as your calculated value? If not, give reasons why this might be.
- **15** Find how many litres of water this rectangular sink will hold if filled to the top.
- **16** List the most suitable volume or capacity unit for measuring these amounts.
 - a the space taken up by a train carriage
 - **b** the liquid in a tea cup
 - c the chocolate in a chocolate bar
 - d the water that a bath can hold





- **17** Provide an estimate of each amount described in question **16**.
- 18 The fuel tank of a car has a capacity of 50 L. How big is the tank? Suggest some possible dimensions if the tank is in the shape of a rectangular prism.
- **19** List two examples of different objects that have a volume close to the following amounts. Explain your choices.
 - **a** 10 cm^3
 - **b** 10 m³
 - **c** 10 mm³

Reflect

What is the difference between volume and capacity?

CHAPTER REVIEW

SUMMARISE

Create a summary of this chapter using the key terms below. You may like to write a paragraph, create a concept map or use technology to present your work.





NAPLAN-STYLE PRACTICE

 Kyle knows that it is exactly 798 m from his house to school. Convert this distance to kilometres.

km

7.5 m

2 Which length measurement is the largest? ☐ 6500 mm ☐ 5600 cm

□ 0.006 km

3 What is the perimeter of this shape?



4 What is the perimeter of a square of length 8 mm?

mm

- 5 A 1-cm grid has been placed over this shape. What is the approximate area of the shape? cm²
- 6 What is the area of a square of length 8 mm?

mm²





 $\bigcirc 30 \text{ cm}^2 \qquad \bigcirc 121 \text{ mm}^2$

8 What is the perimeter of the rectangle?

◯ 30 mm

 \supset 30 cm

- □ 13 cm
 - 🔵 121 mm
- **9** A rectangle has a length of 30 mm and an area of 24 cm². What is the width of the rectangle in centimetres?



16 The area of a square is 49 cm². What is its perimeter?

- cm
- **17** Which shape has the largest area?
 - rectangle with length 70 mm and width 3 cm
 - triangle with base length 10 cm and height 40 mm
 - \bigcirc square with length 5 cm
 - parallelogram with base length 8 cm and height 30 mm

this object. Ella bought a vase for her new house.

Ouestions 18–20 refer to

18 What is the surface area of the outside of the vase?

 $\bigcirc 62 \text{ cm}^2$ $\bigcirc 1236 \text{ cm}^2$

 300 cm^2 1800 cm^2

6 cm

50 cm

6 cm

ANALYSIS

For a friend's birthday, you decide to buy a portable DVD player. There are three within your price range, with slightly different screen dimensions.

Option 1: height 8 cm by width 16 cm Option 2: height 9 cm by width 15 cm Option 3: height 110 mm by width 140 mm

- a The shop assistant tells you that all three have the same screen perimeter. Find the perimeter of each screen. Is the shop assistant correct?
- A friend tells you that if the screens have the same perimeter, they must have the same area.
 Calculate the area of each screen and explain why this is not true.

19 What is the volume of the vase?

 $\bigcirc 62 \text{ cm}^3$ $\bigcirc 1800 \text{ cm}^3$

20 What is the amount of water that this vase could hold?

□ 1.8 L □ 180 L

 \bigcirc 50 cm³

 \supset 300 cm³

□ 1800 L

) 18 L

Questions 21 and 22 refer to a new storage room of length 6 m, width 4 m and height 3 m.

The storage room needs to be painted. There is a door to the room with dimensions 200 cm by 150 cm that has already been painted.

What is the area of the walls, floor and ceiling that would need to be painted?

22 What volume of goods could be stored in the room?

 m^2

m³

- c You decide to select the DVD player that has the widest screen dimension. What disadvantage does this have compared to the other two options?
- d If the DVD player is only 3 cm thick, what is the volume of the smallest box that you could put it in?
- The DVD player comes in a box that measures 100 mm by 200 mm by 50 mm. What is the volume of this box?
- f You will need to wrap the present. Calculate the surface area of the box so that you know the minimum amount of paper you will need.
- g Why might you need a bit more wrapping paper than the minimum? Think about how you wrap objects.

CONNECT

Planning a swimming pool



To build an in-ground swimming pool requires planning and some careful mathematical calculations.

What measurements are needed when planning the building of a backyard swimming pool?

A rectangular section of land of length 12 m and width 9 m has been cleared for an in-ground swimming pool. This land also includes space for paving around the pool and a safety fence. The floor of the pool will be horizontal. This means that the depth of the water will be the same across the whole pool. The concrete walls and floor of the pool are to be painted blue.



Your task

Your task is to design your own swimming pool and calculate each of these measurements:

- the amount of paving required
- the length of safety fencing needed
- the amount of soil to be removed to form the hole for the pool
- the area of the walls and floor of the pool to be painted
- the amount of paint needed to paint the pool
- the amount of water needed to fill the pool
- the amount of plastic material needed for the pool cover
- any other measurements you think are needed.

Another option for the design of an in-ground swimming pool is to have the depth of the pool vary from one end to the other, as shown in this diagram.

Side view of pool

How would this change affect your measurement calculations? Include all necessary working to justify your answer.

Complete the **9 CONNECT** worksheet to show all your working and answers to this task.

You may like to present your findings as a report. Your report could be in the form of:

- a poster
- a PowerPoint presentation
- a scale model
- a video
- other (check with your teacher).









