



Department of
Education

AUSTRALIAN CURRICULUM

MATHEMATICS YEAR 7

**Area formulas
(Rectangles, triangles and parallelograms)**

MATHEMATICS

YEAR 7

Area formulas
(Rectangles, triangles and parallelograms)

Student's name: _____

Teacher's name: _____

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Signposts

Each symbol is a sign to help you.

Here is what each one means:



The recommended time you should take to complete this section.



An explanation of key terms, concepts or processes.



A written response.
Write your answer or response in your journal.



Correct this task using the answers at the end of the resource.



Calculators may not be used here.



Make notes describing how you attempted to solve the problem. Keep these notes to refer to when completing the Self-evaluation task. Your teacher may wish you to forward these notes.

Introduction

This resource should take you approximately two weeks to complete. It comprises seven learning sections, a summary section and a review task section.

The learning sections have the following headings:

- **Key words**
These are the main words that you need to understand and use fluently to explain your thinking.
- **Warm-up**
Warm-up tasks should take you no longer than 10 minutes to complete. These are skills from previous work you are expected to recall from memory, or mental calculations that you are expected to perform quickly and accurately. If you have any difficulties in answering these questions, please discuss them with your teacher.
- **Review**
Some sections have reviews immediately after the warm-up. The skills in these reviews are from previous work and are essential for that section. You will use these to develop new skills in mathematics. Please speak to your teacher immediately if you are having any trouble in completing these activities.
- **Focus problem**
Focus problems are designed to introduce new concepts. They provide examples of the types of problems you will be able to solve by learning the new concepts in this resource. Do not spend too long on these but do check and read the solutions thoroughly.
- **Skills development**
These help you consolidate new work and concepts. Most sections include skills development activities which provide opportunities for you to become skilled at using new procedures, apply your learning to solve problems and justify your ideas. Please mark your work after completing each part.

Correcting your work

Please mark and correct your work as you go. Worked solutions are provided to show how you should set out your work. If you are having any difficulty in understanding them, or are getting the majority of the questions wrong, please speak to your teacher immediately.

Journal

Please keep an exercise book to record your notes and to summarise your learning. At the end of each section, write definitions for the key words that were introduced for that section.

Curriculum details

Content Descriptions

This resource provides learning and teaching to deliver the Australian Curriculum: Mathematics for the following Year 7 Content Descriptions.

Establish the formulas for areas of rectangles, triangles and parallelograms and use these in problem solving (ACMMG159)

Content descriptions	1	2	3	4	5	6	7	R
ACMMG159								



Indicates the content description is explicitly covered in that section of the resource.

Previous relevant Content Descriptions

The following Content Descriptions should be considered as prior learning for students using this resource.

At Year 5 level

Calculate the perimeter and area of rectangles using familiar metric units (ACMMG109)

At Year 6 level

Convert between common metric units of length, mass and capacity (ACMMG136)

Solve problems involving the comparison of lengths and areas using appropriate units (ACMMG137)

Proficiency strand statements at Year 7 level

At this year level:

Understanding includes describing patterns in uses of indices with whole numbers, recognising equivalences between fractions, decimals, percentages and ratios, plotting points on the Cartesian plane, identifying angles formed by a transversal crossing a pair of lines, and connecting the laws and properties of numbers to algebraic terms and expressions

Fluency includes calculating accurately with integers, representing fractions and decimals in various ways, investigating best buys, finding measures of central tendency and calculating areas of shapes and volumes of prisms

Problem Solving includes formulating and solving authentic problems using numbers and measurements, working with transformations and identifying symmetry, calculating angles and interpreting sets of data collected through chance experiments

Reasoning includes applying the number laws to calculations, applying known geometric facts to draw conclusions about shapes, applying an understanding of ratio and interpreting data displays

General capabilities

General capabilities	1	2	3	4	5	6	7	R
Literacy								
Numeracy								
Information and communication technology (ICT) capability								
Critical and creative thinking								
Personal and social capability								
Ethical behaviour								
Intercultural understanding								



Indicates General capabilities are explicitly covered in that section of the resource.

Cross-curriculum priorities

Cross-curriculum priorities	1	2	3	4	5	6	7	R
Aboriginal and Torres Strait Islander histories and cultures								
Asia and Australia's engagement with Asia								
Sustainability								



Indicates Cross-curriculum priorities are explicitly covered in that section of the resource.

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1. Perimeter and area review

When you complete this section you should be able to:

- understand and explain the difference between perimeter and area.

Key words

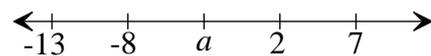
- perimeter
- area
- dimension

Warm-up 1

1. Circle the factor of 8. 3, 4, 5, 6, 7

2. $5 + 7 =$ _____

3. What is the missing number?



$a =$ _____

4. Circle the fraction that is greater? $\frac{2}{3}$ or $\frac{3}{6}$

5. What is a half of 18? _____

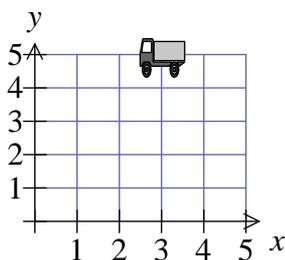
6. $4 - 0.2 =$ _____

7. $4.2 \times 5 =$ _____

8. Write 0.1 as a fraction. _____

9. Complete: 94, 96, 98, _____

10.



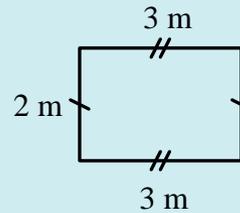
The truck is at (3, 5).

If the truck moves 3 units down and 2 units left, where will it then be? _____

Review 1.1

Example

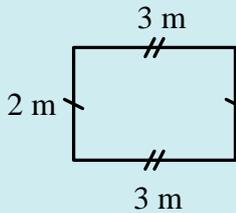
Determine the **perimeter** of the following rectangle.



Solution

Perimeter is the distance around the outside of a shape.

Therefore, to find the perimeter of a shape, add together the lengths (or **dimensions**) of all the sides.

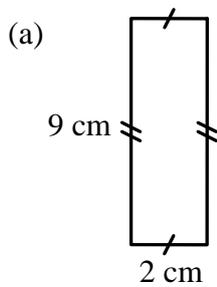


This side's measurement is not given. However, it is the same length as the opposite side. (This is known because both sides have the same markings. It also holds true that for all rectangles the opposite sides are equal lengths.)

$$\begin{aligned} \textit{Perimeter} &= 3 + 2 + 3 + 2 \\ &= 10 \end{aligned}$$

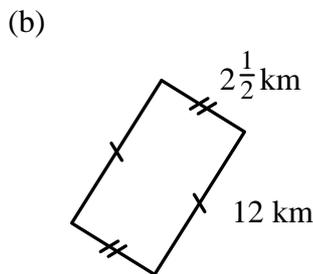
∴ The perimeter is 10 m.

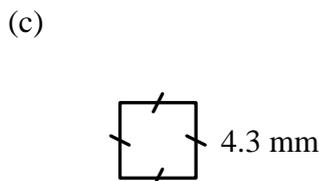
1. Determine the perimeter for each of the following rectangles.



$$\begin{aligned} \textit{Perimeter} &= \underline{\hspace{2cm}} + \underline{\hspace{2cm}} + \underline{\hspace{2cm}} + \underline{\hspace{2cm}} \\ &= \underline{\hspace{4cm}} \end{aligned}$$

∴ The perimeter is cm.

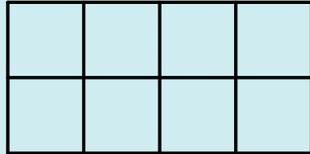




Review 1.2

Example

Determine the **area** of the following shape.



Solution

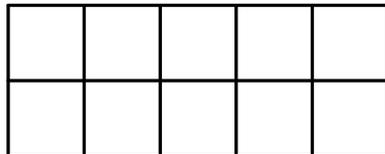
Area is the amount of material needed to ‘cover’ a surface. Generally it is measured in square units. It can be found by counting the number of squares.

1	2	3	4
5	6	7	8

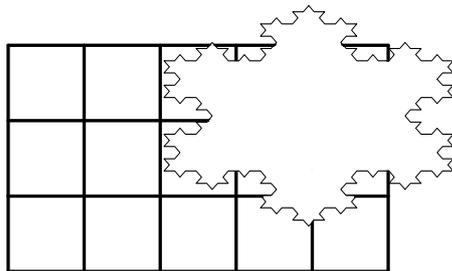
∴ The area is 8 square units.

1. Determine the area for each of the following rectangles.

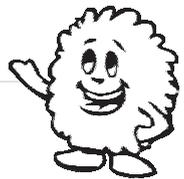
(a)



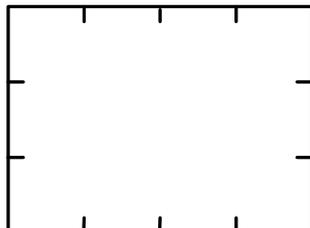
(b)



Hmmm, some of the squares are hidden.



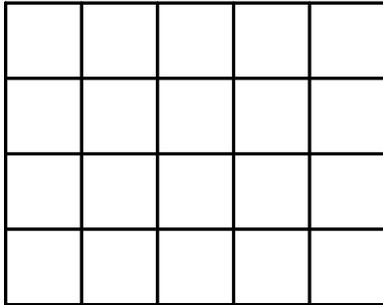
(c)



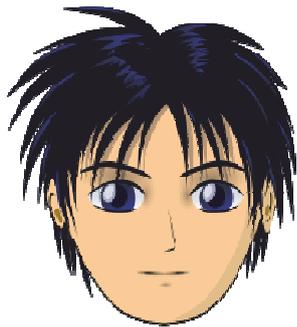
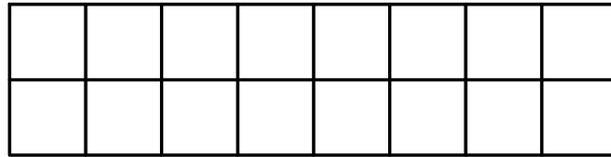
Focus problem 1

Charlie and Seiko are discussing some mathematical ideas to do with the two rectangles drawn below.

Rectangle A



Rectangle B



Hey Seiko, I believe the rectangle with the larger **perimeter** will have the larger **area**.



Well Charlie, that can be true for some rectangles, but it is not true for these two

Who do you believe is correct? Justify your decision.

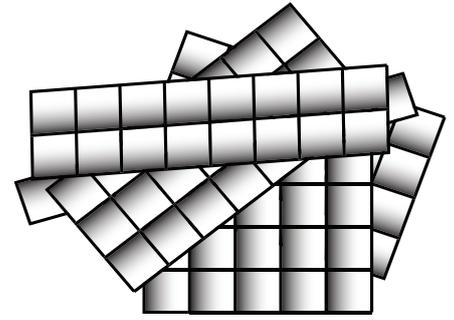


Check your work before continuing.

Investigation 1

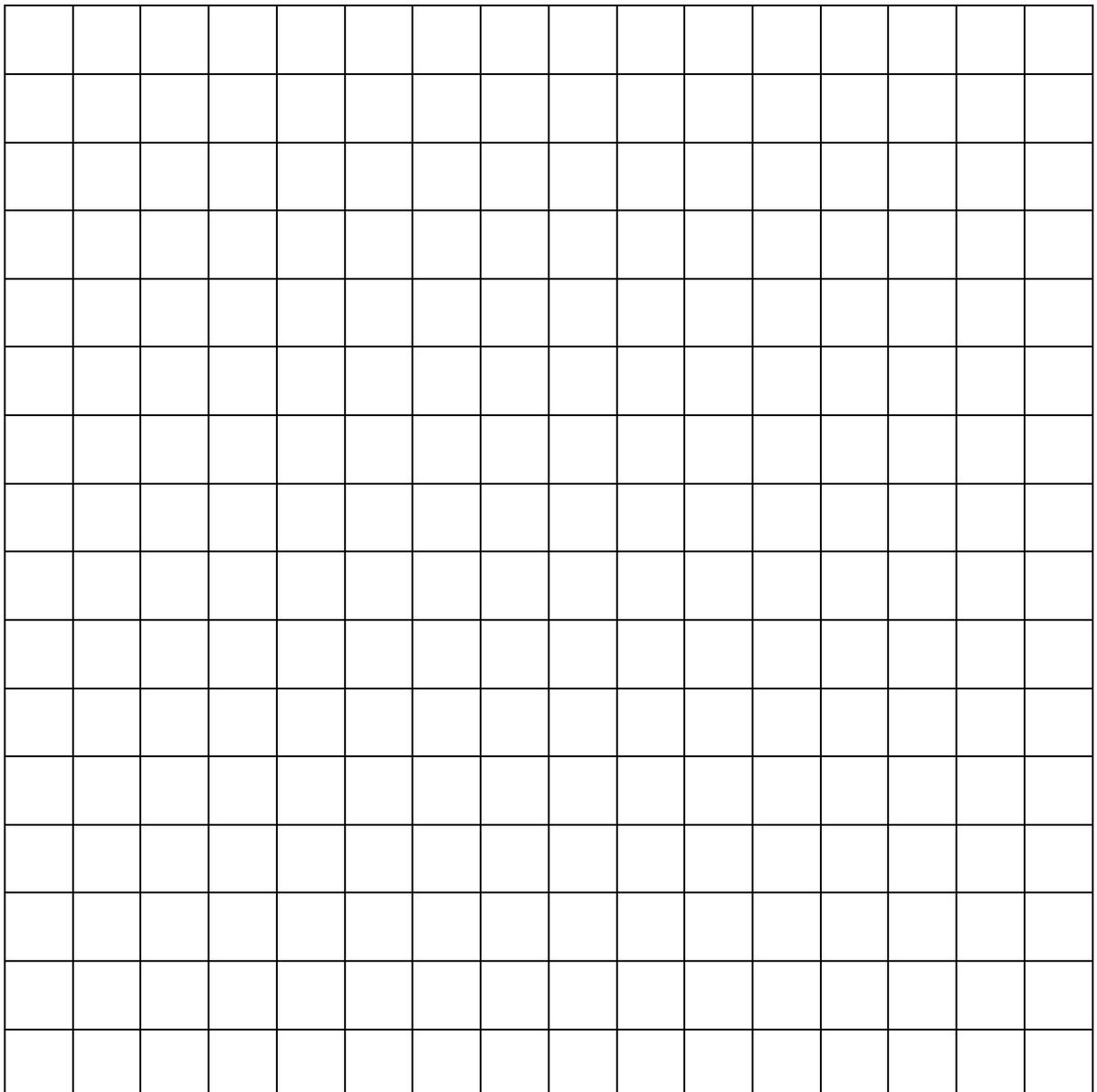
Raul has five chocolate bars that he is planning to give away.

Each bar has the same thickness and a **perimeter** of 20 cm. The bars are made up of 1 cm^2 squares.



1. Do you think each bar has the same amount of chocolate? Why?

2. Draw each chocolate bar separately below. Label the **dimensions** of each.



3. Use your drawings of the chocolate bars to complete the following table.

Chocolate bars	dimensions		<i>Perimeter</i> (cm)	<i>Area</i> (cm ²)
	<i>length</i>	<i>width</i>		
1	1	9	20	9
2	2	8		
3				
4				
5				

4. Write one or two sentences about what you have noticed. Try to use the words perimeter and area in your answer.

5. Raul had six other rectangular chocolate bars. Their perimeters were all 24 cm. If you had to choose the chocolate bar with the largest area:

(a) What size rectangle would you choose? (List its dimensions.) _____

(b) What area would it have? _____

6. Use your own words to describe each of the following.

(a) perimeter _____

(b) area _____

(c) dimension _____



Check your work before continuing.

2. Area of rectangles

When you complete this section you should be able to:

- establish and use the formula for finding the area of a rectangle.

Keywords

- formula

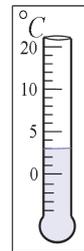
Warm-up 2

1. Circle the common factor of 24 and 30. 5, 6, 7, 8, 9

2. $14 - 8 =$ _____

3. The temperature was 3 degrees but it dropped 8 degrees.

What is the new temperature? _____



4. Insert $<$, $>$ or $=$ to make the following sentence true.

$$\frac{2}{3} \square \frac{3}{4}$$

5. $\frac{1}{2} \times 12 =$ _____

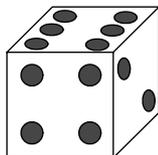
6. Round 3.2 to a whole number. _____

7. $4.8 \div 2 =$ _____

8. Write 50% as a decimal. _____

9. Complete: 0.1, 0.3, 0.5, _____

10. A six-sided die is rolled.

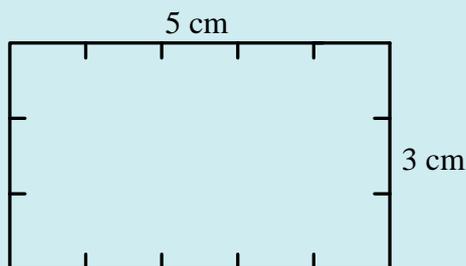


Express, as a percentage, the probability that it lands on a prime number.

Review 2.1

Example

Determine the area of the following rectangle.

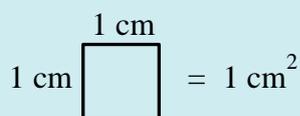


Solution

The area can be found by dividing the shape into square units and then counting them.



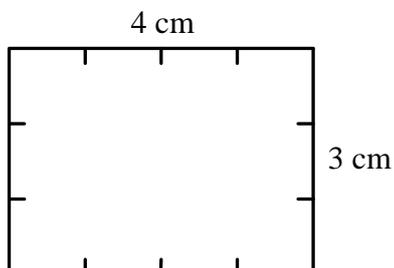
The units in this case are square centimetres (cm^2).



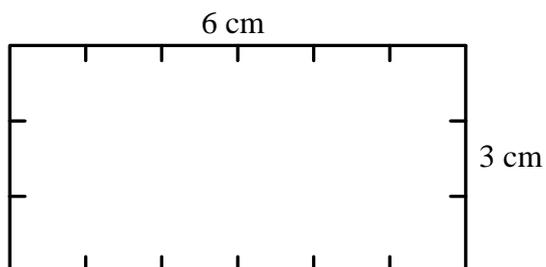
\therefore The area is 15 cm^2 .

1. Determine the area for each of the following rectangles.

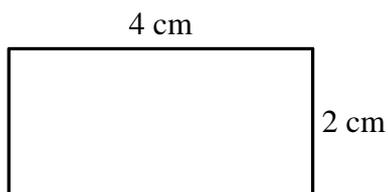
(a)

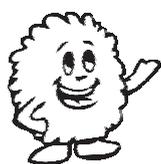


(b)



(c)



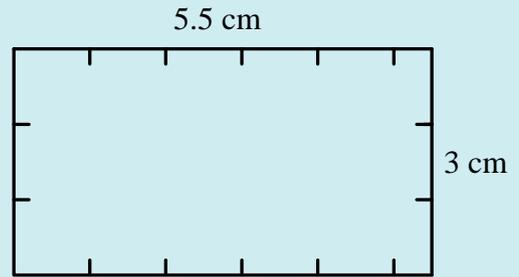


It looks like I'll have to divide up this last rectangle by myself.

Review 2.2

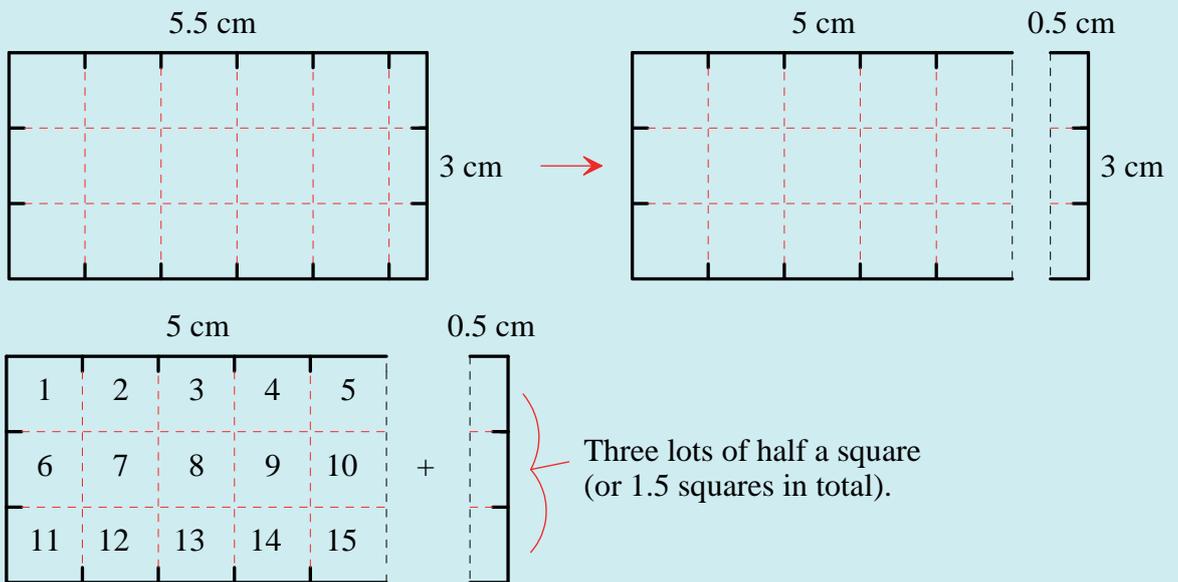
Example

Determine the area of the following rectangle.



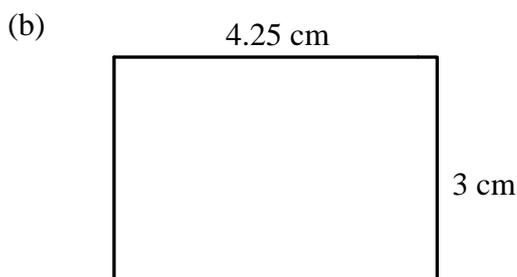
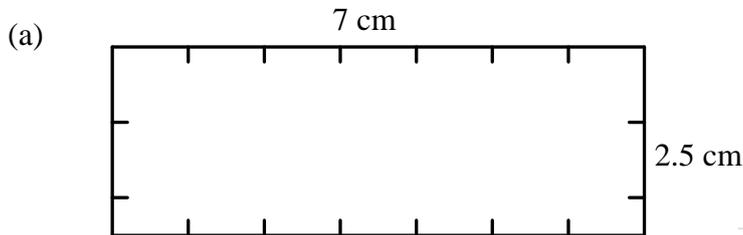
Solution

The area can be found by dividing the shape into square units, as before. However, this is slightly different as there are also parts of squares. Combine the parts of squares together to make whole squares and then add them to the count.



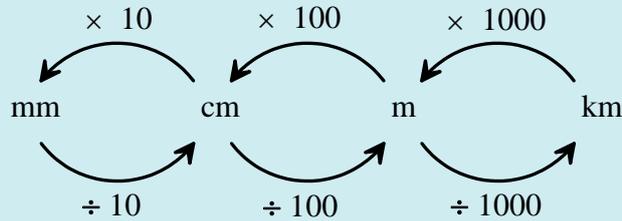
∴ The area is $15 + 1.5 = 16.5$ square units or 16.5 cm^2 .

1. Determine the area for each of the following rectangles.



Review 2.3

When finding areas, you will sometimes need to convert units of length. The following diagram may help you to convert some common units of length.



Example

Convert the following units of length.

- (a) 4.5 cm to mm
 (b) 8900 mm to m

Solution

- (a) $4.5 \times 10 = 45$
 $\therefore 4.5 \text{ cm} = 45 \text{ mm}$
- (b) $8900 \div 10 = 890$
 $890 \div 100 = 8.9$
 $\therefore 8900 \text{ mm} = 8.9 \text{ m}$



So for part (b), I convert millimetres into centimetres and then into metres.



Yes, or you can just convert straight from millimetres to metres. It's entirely your choice.

1. Convert the following units.

- (a) 6.5 km = _____ m
 (b) 731 cm = _____ m
 (c) 28 mm = _____ cm
 (d) 36 cm = _____ mm
 (e) 8400 m = _____ km
 (f) 4800 mm = _____ m
 (g) 3.52 m = _____ cm
 (h) 2.1 km = _____ cm

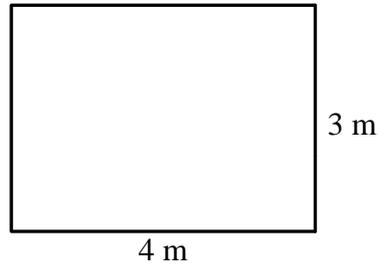


Check your work before continuing.

Focus problem 2

Soma's carpet in his bedroom needs to be replaced. The bedroom is rectangular with a length of 4 metres and a width of 3 metres.

How much carpet will Soma need?



Check your work before continuing.

'Tufts' to that

Carpets have been around for at least 5000 years, with the first hand-knotted pile believed to have been created in central Asia. In fact, there is some suggestion that goats and sheep were sheared and their wool woven to form carpets some 8000 years ago.

These days, carpets are generally made using synthetic materials such as nylon, with 'tufts' inserted into a backing material.

Although the US and European countries have manufactured the majority of carpet for the last 100 years, China is becoming an ever increasing player in the carpet industry, with both its export and internal markets growing very fast. As the standard of living in China increases, carpet is becoming more affordable to its people.

Skills development 2.1

Example

Use the following **formula** to find the area of the rectangle.

$$\text{Area}_{(\text{rectangle})} = \text{length} \times \text{width}$$



Solution

$$\begin{aligned} A_{(\text{rectangle})} &= l \times w \\ &= 5.5 \times 2 \\ &= 11 \end{aligned}$$



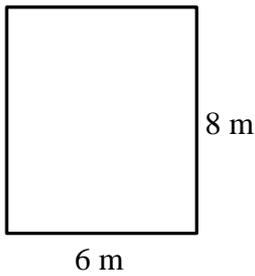
Did you see how a single letter is used to represent the variables in the formula?

∴ The area of the rectangle is 11 m².

Note that the units are called ‘square metres’ but are written as m².

1. Calculate the area of the following rectangles using the area formula.

(a)

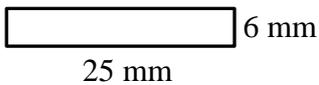


$$A_{(\text{rectangle})} = l \times w$$

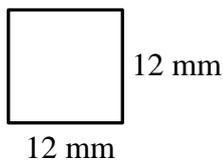
$$\begin{aligned} &= \underline{\hspace{2cm}} \times \underline{\hspace{2cm}} \\ &= \underline{\hspace{2cm}} \end{aligned}$$

∴ The area of the rectangle is m².

(b)



(c)

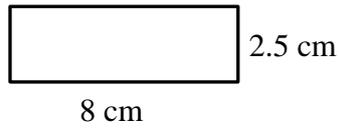


But that’s a square?!?

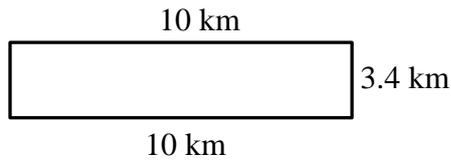


Well yes, that’s right. A square is a special type of rectangle.

(d)

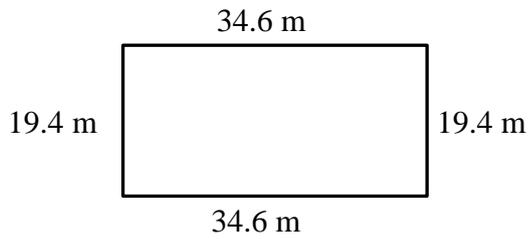


(e)



Make sure you use the correct length and width.

(f)



2. Using your own words describe the meaning of formula.



Check your work before continuing.

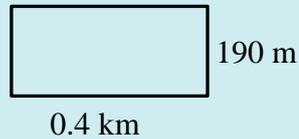
Skills development 2.2

Before using an area **formula**, you must ensure that all units are the same.

Example

Use the following formula to find the area of the rectangle in square metres.

$$Area_{\text{(rectangle)}} = \text{length} \times \text{width}$$



Solution

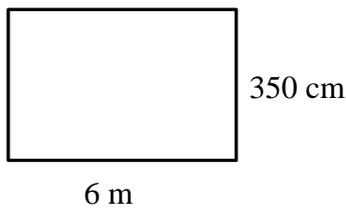
$$0.4 \times 1000 = 400$$

$$\begin{aligned} A_{\text{(rectangle)}} &= l \times w \\ &= 400 \times 190 \\ &= 76\,000 \end{aligned}$$

\therefore The area of the rectangle is $76\,000 \text{ m}^2$.

1. Calculate the area of the following rectangles using the area formula.

(a)



$$350 \div 100 = \underline{\hspace{2cm}}$$

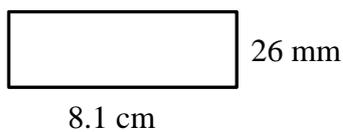
$$A_{\text{(rectangle)}} = l \times w$$

$$= \underline{\hspace{2cm}} \times \underline{\hspace{2cm}}$$

$$= \underline{\hspace{2cm}}$$

\therefore The area of the rectangle is $\underline{\hspace{2cm}} \text{ m}^2$.

(b)



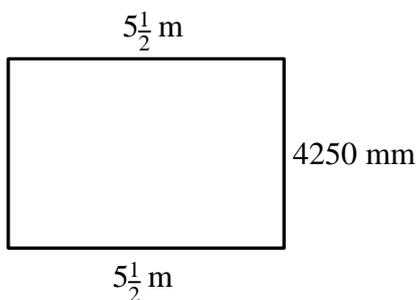
$\underline{\hspace{2cm}}$

$\underline{\hspace{2cm}}$

$\underline{\hspace{2cm}}$

$\underline{\hspace{2cm}}$

(c)



$\underline{\hspace{2cm}}$

$\underline{\hspace{2cm}}$

$\underline{\hspace{2cm}}$

$\underline{\hspace{2cm}}$



Check your work before continuing.

3. Parallelogram area formula

When you complete this section you should be able to:

- establish the formula for finding the area of a parallelogram.

Keywords

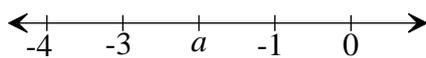
- parallelogram
- perpendicular height

Warm-up 3

1. Circle the prime numbers. 1, 2, 3, 4, 5, 6

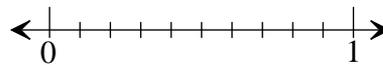
2. $6 \times 9 =$ _____

3. What is the missing number?



$a =$ _____

4. Locate $\frac{1}{2}$ on the number line.



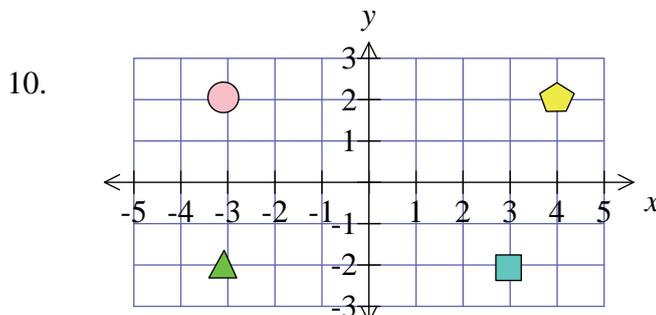
5. What is a third of 12? _____

6. Estimate the sum by first rounding to whole numbers. $4.9 + 5.1 \approx$ _____

7. $7 \times 1.1 =$ _____

8. Write $\frac{1}{2}$ as a percentage. _____

9. Complete: $\frac{1}{4}, \frac{2}{4}, \frac{3}{4},$ _____

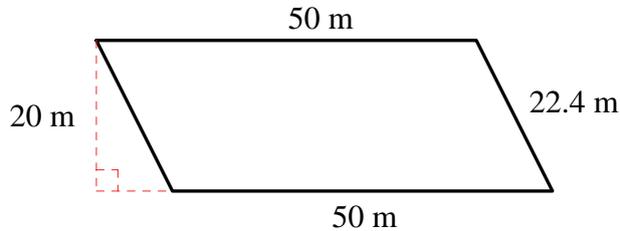
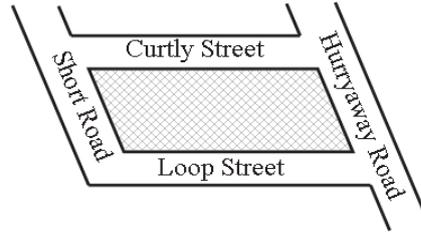


Which shape is at (3, -2)?

Focus problem 3

Eugene was asked to determine the amount of land available between the roads in the map on the right.

Eugene worked out the dimensions of the land.



Use Eugene's measurements to determine the amount of land available for sale.



Check your work before continuing.

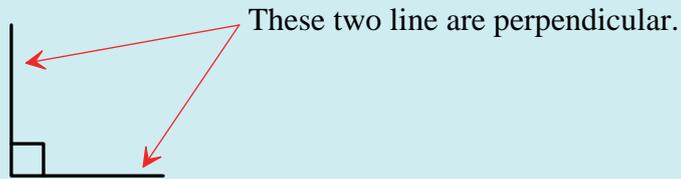
A parallel universe

The word parallel is used in many contexts. It is used in electronics to describe circuits that have the same voltage (and share the same current). It is used in geography to describe imaginary lines that divide up the Earth's surface into latitude. You can even have parallel evolution or universes!

Of course, in maths where the 'real' use of parallel occurs, it refers to lines that stay the same distance apart.

Skills development 3

Perpendicular means to be at right angles or at 90 degrees.



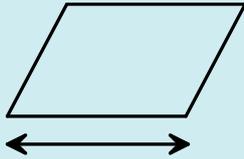
Perpendicular height is therefore the height taken at right angles or 90° from the base. Note that the base can be any chosen side.

Example

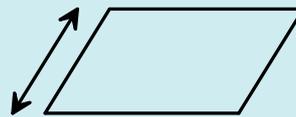
The side chosen to be used as the base has been marked with an arrow.

For each **parallelogram**, indicate the perpendicular height.

(a)



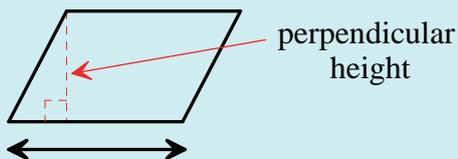
(b)



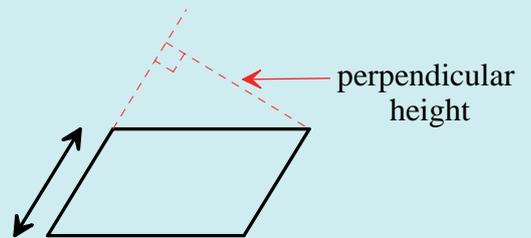
Solution

As the height can be taken from any point on the base, your solutions may vary slightly. The following only shows one location for each parallelogram.

(a)



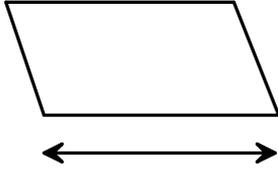
(b)



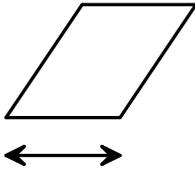
Note that the line that represents the perpendicular height can be drawn inside or outside the shape.

1. The side chosen to be used as the base for each **parallelogram** has been marked with an arrow. For each of the following, mark (or add lines if needed) to indicate the **perpendicular height**.

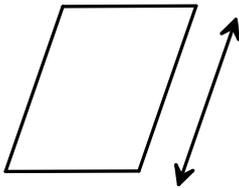
(a)



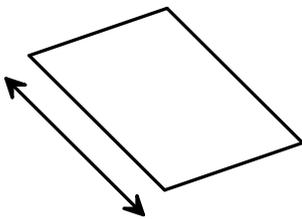
(b)



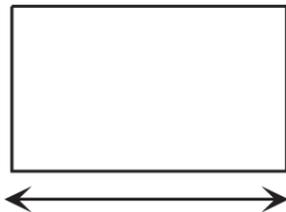
(c)



(d)



(e)



Isn't that shape in (e) a rectangle?



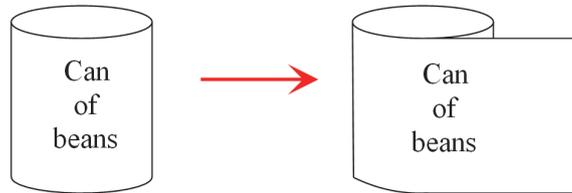
Yes, well spotted! A rectangle is a type of parallelogram.



Investigation 3 (Adult supervision required!)

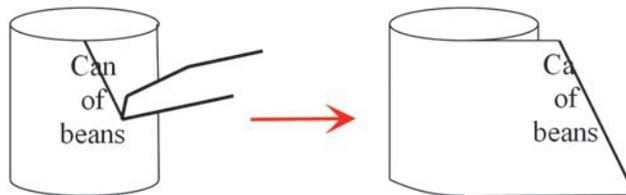
Part 1

- Find two tin cans that have the same dimensions. That is, they must be the same size. (Ask your parents/guardians first before raiding the pantry!)
- With adult supervision, use a pair of scissors or a knife to cut one of the labels off. (Sometimes you can just pull the label off without cutting it.)

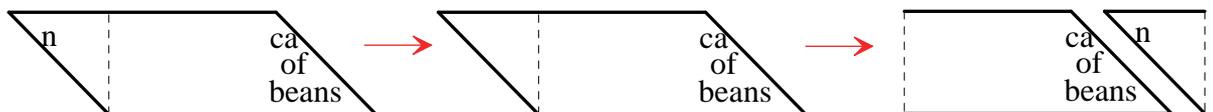


- Spread the label out flat. What shape is it? _____
- Determine the area of the label. (You will need to take some measurements first.)

- Wrap the label around the can that still has its label.
- Do you think the areas of both labels are the same? _____
- With adult supervision, use a pair of scissors or a knife to cut off the label of the second can on an angle, as shown below.



- Spread the label out flat. What shape is it? _____
- Cut the triangular end off the shape and fit it to the other end.



- Describe the new shape. _____
- Determine the area of the new shape. (You will need to take some measurements first.)

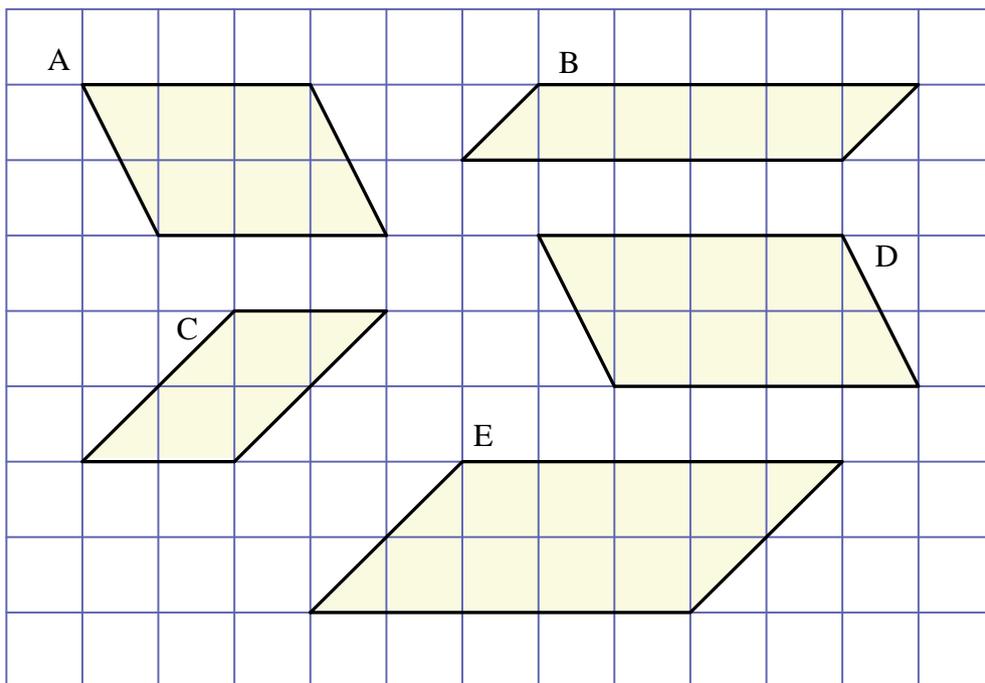
- Compare your answers for part 4 and part 11. What did you find?



Check your work before continuing.

Part 2

The following **parallelograms** have been drawn on a 1 cm^2 grid.



- Find the area of each parallelogram by counting squares. You will need to join some part squares together to make whole squares. Write the area of each inside the shape.
- Check your answers for part 1, and then complete the table below.
(The first row has been done for you.)

Parallelograms	<i>base (b)</i>	<i>perpendicular height (h)</i>	<i>Area (A)</i>
A	3 cm	2 cm	6 cm^2
B			
C			
D			
E			

- Can you work out the rule for finding the area of a parallelogram? What is the rule?
Complete this formula:

$$\text{Area}_{\text{ (parallelogram)}} = \underline{\hspace{10em}}.$$



Check your work before continuing.

4. Area of parallelograms

When you complete this section you should be able to:

- use the formula for finding the area of a parallelogram.

Warm-up 4

1. List the first 5 prime numbers. _____

2. $42 \div 7 =$ _____

3. The temperature was minus 3 degrees but it went up 5 degrees.

What is the new temperature? _____

4. Express the value of w as a fraction.



$w =$ _____

5. $\frac{1}{3} \times 15 =$ _____

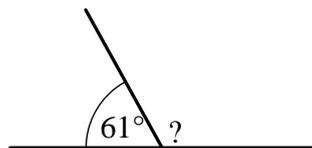
6. $29.8 \div 10 =$ _____

7. $8.13 \div 3 =$ _____

8. Write 25% as fraction. _____

9. Complete: 41, 37, 33, _____.

10. Determine the size of the missing angle.

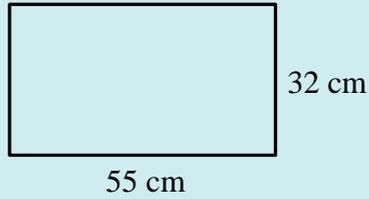


Review 4

Example

Find the area for the following rectangle.

$$Area_{\text{(rectangle)}} = \text{length} \times \text{width}$$

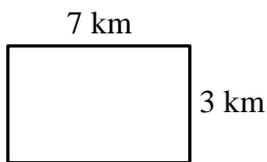
**Solution**

$$\begin{aligned} A_{\text{(rectangle)}} &= l \times w \\ &= 32 \times 55 \\ &= 1760 \end{aligned}$$

\therefore The area of the rectangle is 1760 cm^2 .

1. Calculate the area for each of the following rectangles.

(a)



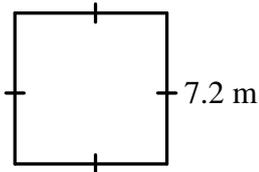
$$A_{\text{(rectangle)}} = l \times w$$

$$= \underline{\hspace{2cm}} \times \underline{\hspace{2cm}}$$

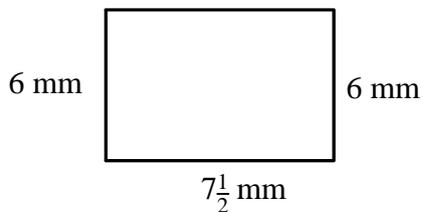
$$= \underline{\hspace{2cm}}$$

\therefore The area of the rectangle is $\underline{\hspace{2cm}} \text{ km}^2$.

(b)



(c)

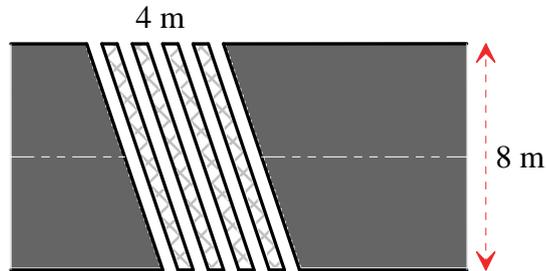




Remember to use the correct dimensions.

Focus problem 4

While driving home late one night, Ranine accidentally left the plough down on her tractor. Unfortunately, Ranine also decided to take a short cut which ran straight through a newly bituminised road.



How much of the road has been damaged?



Check your work before continuing.

A road to nowhere

Bitumen (or asphalt) is a black, thick, sticky oil-based substance. It is the by-product of decomposed organic materials, like oil and gas. In the past, bitumen was used to waterproof boats and buildings, but these days it is more commonly used to construct roads.

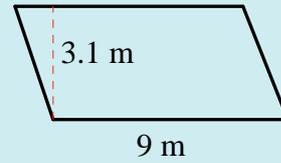
The production of bitumen impacts on the environment. For example, like all petroleum products, its refinement releases hydrogen sulphide (rotten egg gas) into the atmosphere. Bitumen can also contain heavy metals and other contaminants. As the bitumen breaks down, these contaminants are leached-out and enter the natural environment. You can probably understand that water run-off from roads is a major concern, especially when you add the toxins released by all the petroleum-fuelled cars.

Skills development 4.1

Example

Given the following rule, determine the area for the parallelogram.

$$Area_{\text{(parallelogram)}} = \text{base} \times \text{perpendicular height}$$



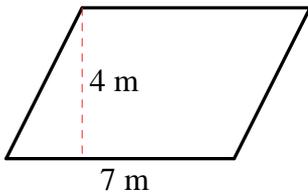
Solution

$$\begin{aligned} A_{\text{(parallelogram)}} &= b \times h \\ &= 9 \times 3.1 \\ &= 27.9 \end{aligned}$$

∴ The area is 27.9 m².

1. Determine the area for each of the following parallelograms.

(a)



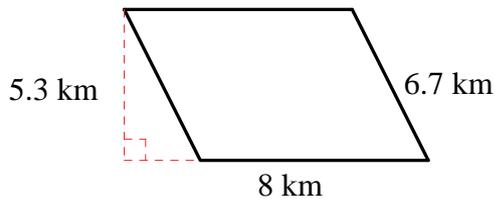
$$A_{\text{(parallelogram)}} = b \times h$$

$$= \underline{\hspace{2cm}} \times \underline{\hspace{2cm}}$$

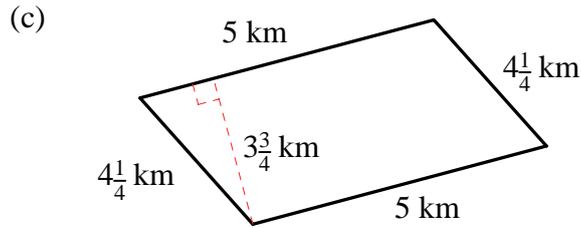
$$= \underline{\hspace{2cm}}$$

∴ The area is $\underline{\hspace{2cm}}$ m².

(b)



Remember not all dimensions are needed so use the correct measurements and the correct setting out.

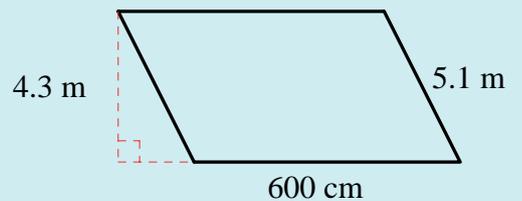


Skills development 4.2

Example

Use the formula below to determine the area in square metres for the parallelogram.

$$Area_{\text{(parallelogram)}} = \text{base} \times \text{perpendicular height}$$



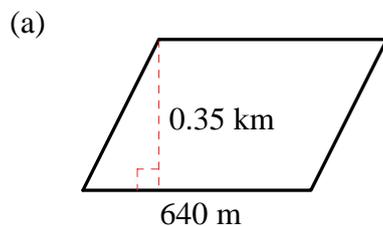
Solution

$$600 \div 100 = 6$$

$$\begin{aligned} A_{\text{(parallelogram)}} &= b \times h \\ &= 6 \times 4.3 \\ &= 25.8 \end{aligned}$$

∴ The area is 25.8 m².

1. Determine the area of the following parallelograms.



$$0.35 \times 1000 = \underline{\hspace{2cm}}$$

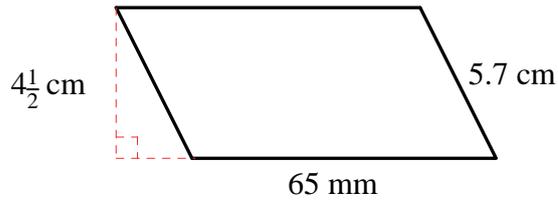
$$A_{\text{(parallelogram)}} = b \times h$$

$$= \underline{\hspace{2cm}} \times \underline{\hspace{2cm}}$$

$$= \underline{\hspace{2cm}}$$

∴ The area is $\underline{\hspace{2cm}}$ m².

(b)



2. The formula for finding the area of a parallelogram is given below.

$$\text{Area}_{(\text{parallelogram})} = \text{base} \times \text{perpendicular height}$$

(a) What is meant by perpendicular height? _____

(b) What is a parallelogram? _____

3. Draw a parallelogram, measure the dimensions and then determine the area using the formula. Ask an adult to check your work.



Check your work before continuing.

5. The area of triangle formula

When you complete this section you should be able to:

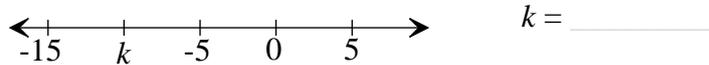
- find the area of triangles.

Warm-up 5

1. List the first 5 square numbers. _____

2. $15 + 17 =$ _____

3. What is the missing number?



4. $\frac{1}{4} + \frac{2}{4} =$ _____

5. What is a quarter of 16? _____

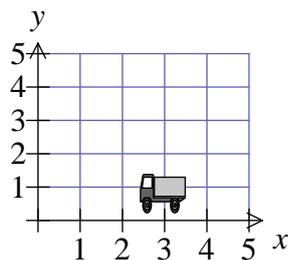
6. 4.2 cm = _____ mm

7. $2 + 5 \times 5 =$ _____

8. Write $3\frac{1}{2}$ as a decimal. _____

9. Complete: 2.8, 2.5, 2.2, _____..

10.



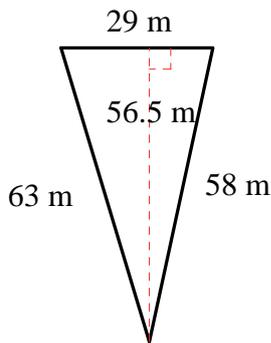
At what point is the truck? _____

Focus problem 5

Bern, a New York real estate agent, was asked to determine the floor space of the Flatiron building.

Built in the early 1900s, the shape of the Flatiron is formed by the intersection of three roads.

Its dimensions are shown below.



What is the floor space of one of the levels?



Check your work before continuing.

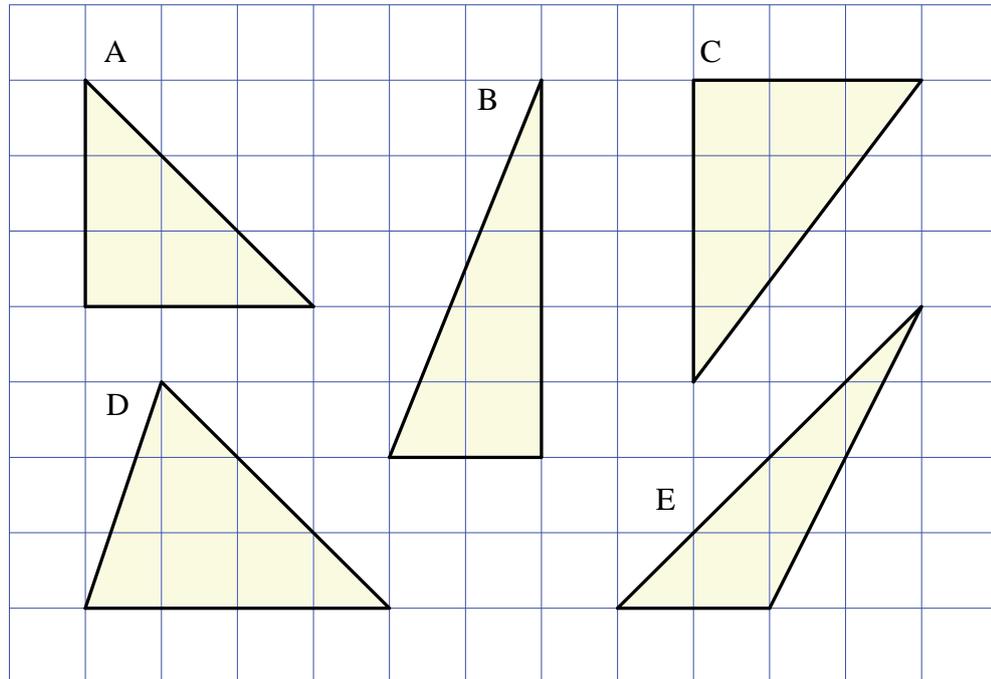
Sky scraping

Seven of the ten tallest buildings have been built in the Asian region. One such building is the Taipei 101 tower in Taiwan. Completed in 2004, it reaches almost 450 metres in height*, with 101 above-ground floors and 5 underground floors. The speed of its elevator reaches over 60 kilometres per hour. Now that's fast for an elevator!

*The height is given as the height of the building's roof. On top of this, the building has a 60 metre spire, making its overall height 509 metres.

Investigation 5

The following triangles have been drawn on a square-centimetre (cm^2) grid.



- Find the area (in cm^2) of each triangle. (Add together part squares to form whole squares.) Write the area inside the shape.
- Check your answers for part 1, and then complete the table below. (The first row has been done for you.)

Triangles	base (b)	perpendicular height (h)	Area (A)
A	3 cm	3 cm	4.5 cm^2
B			
C			
D			
E			

- Analyse the information in the table. Can you work out the rule for finding the area of a triangle? What is the rule?

Complete this formula:

$$\text{Area}_{\text{ (triangle)}} = \underline{\hspace{10em}}.$$



Check your work before continuing.

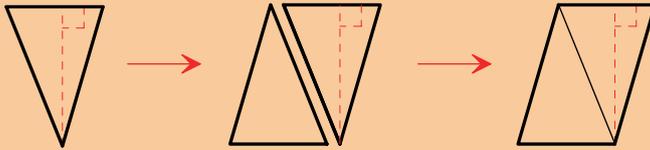
Are you seeing similarities?

You may recognise the underlined part of the following triangle formula from your previous work on parallelograms.

$$A_{\text{(triangle)}} = \frac{1}{2} \times \textit{base} \times \textit{perpendicular height}$$

$$A_{\text{(parallelogram)}} = \textit{base} \times \textit{perpendicular height}$$

That's because a triangle is half a parallelogram.



Activity 5.1

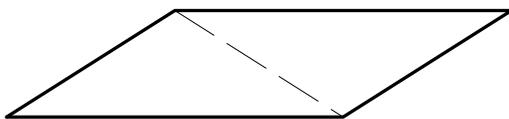
1. On a separate piece of paper, draw a parallelogram.
2. Measure its base and perpendicular height and then determine its area.

length of base: _____

perpendicular height: _____

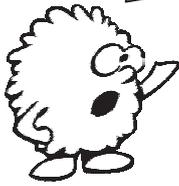
area: _____

3. Cut out the parallelogram.
4. Draw a line from corner to corner, similar to the one shown below.



5. Cut the parallelogram along the line (which was drawn in part 4).
6. Place one of the cut pieces on top of the other one, so that they completely overlap.
What shape is formed? _____
7. Determine the area of this new shape. _____
8. Compare the area you found in part 7 with the area you found in part 2.
What do you notice? _____

Can all triangles be made into parallelograms?



Complete one of the following activities and see for yourself.



Activity 5.2

You can choose to do either the following hi-tech or the low-tech activity.

Hi-tech activity: Using a computer program

1. Open up your computer's drawing program.
 2. Draw a triangle.
 3. Select the triangle and copy it. (When it's selected press Ctrl C.)
 4. Paste the copy. (Press Ctrl V.) Note that sometimes you may need to change the settings in your program so that you can see both triangles at once.
 5. Rotate one of the triangles 180° .
 6. Now line up the two triangles and take note of the new shape.
 7. Try the above steps with some other triangles.
 8. Which type of triangles form rectangles? Which form squares?
-

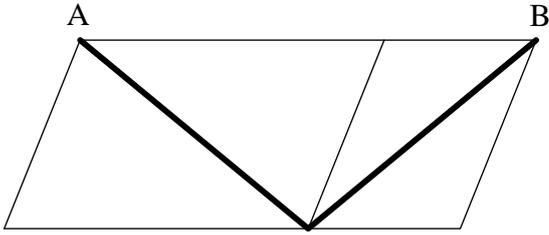
Low-tech activity: Pen & paper

1. On a separate piece of paper, draw a triangle.
 2. Cut it out.
 3. Trace the outline of the triangle onto another piece of paper.
 4. Now turn (rotate) the cut-out triangle until a parallelogram is formed. (This can include a rectangle or square). If you have accidentally flipped the shape you will end up with a kite instead. Just flip it back over and try it again.
 5. Try the above steps with some other triangles.
 6. Which type of triangles form rectangles? Which form squares?
-



Check your work before continuing.

Paralleling puzzle?



Which one of the thick lines is the longest? A or B?



6. Area of triangles

When you complete this section you should be able to:

- use the formula for finding the area of a triangle.

Warm-up 6

1. $9.8 \times 10 =$ _____

2. $23 - 18 =$ _____

3. The temperature is minus 5 degrees.

How much will it need to rise to reach zero degrees? _____

4. $\frac{5}{6} - \frac{3}{6} =$ _____

5. $\frac{1}{4} \times 12 =$ _____

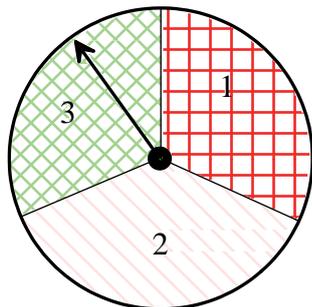
6. $8 \text{ kg} =$ _____ g

7. $2 \times 5 + 5 =$ _____

8. Write 0.25 as a percentage. _____

9. Complete: $\frac{11}{4}, 2, \frac{5}{4},$ _____

10. Determine the probability the spinner will land on a 1 or a 2.



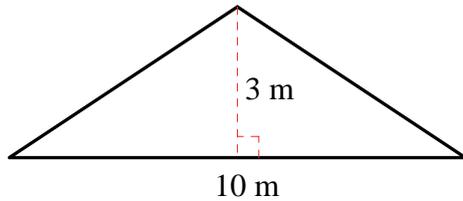
Express your answer as a fraction.

Focus problem 6

Tahiti is renovating her house and found that the triangular gable section is in need of some painting.

Unfortunately Tahiti only had a small can of the paint which would barely cover 20 m^2 .

The triangle section had the following measurements.



Will Tahiti need to buy more paint?



Check your work before continuing.

Painting your house

There are basically two types of paint, an oil-based paint and a water-based paint. Oil-based paint is more durable (that is, it lasts longer) than water-based paint, so it is used on the outside of the house. Water-based paint can be cleaned up with soap and water and has little odour, so it's generally used on the inside of the house.

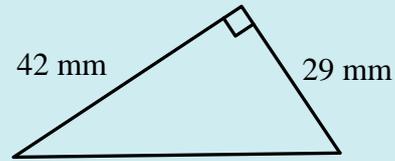
Paint and painting have been around for a very long time. The Chinese are said to have manufactured paint tens of thousands of years ago. And of course, Australia's traditional owners have been using ochre as face paint and in cave paintings for over 40 000 years.

Skills development 6.1

Example

Find the area for the following triangle.

$$\text{Area}_{(\text{triangle})} = \frac{1}{2} \times \text{base} \times \text{height}$$



Solution

$$\begin{aligned} A_{(\text{triangle})} &= \frac{1}{2} \times b \times h \\ &= \frac{1}{2} \times 42 \times 29 \\ &= 609 \end{aligned}$$

\therefore The area of the rectangle is 609 mm^2 .

Note the units are called 'square millimetres', written as mm^2 .



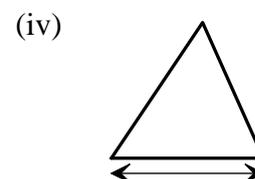
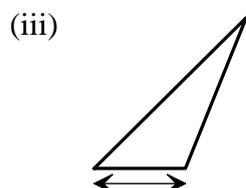
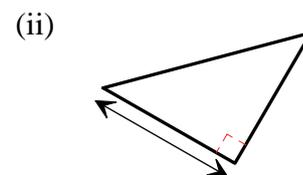
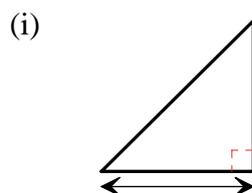
Note that any side can be considered to be the base.

1. The formula for finding the area of a triangle is given below.

$$\text{Area}_{(\text{triangle})} = \frac{1}{2} \times \text{base} \times \text{perpendicular height}$$

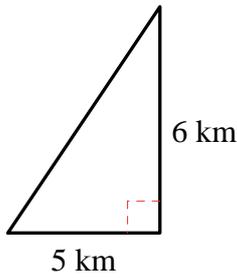
- (a) What is meant by perpendicular height? _____

- (b) The side chosen as the base has been marked on each triangle with an arrow. Mark each triangle, adding lines if needed, to indicate the perpendicular height.



2. Determine the area for each of the following triangles.

(a)



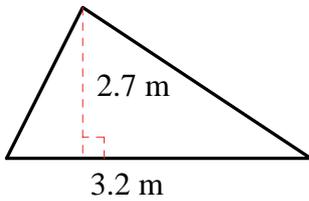
$$A_{\text{(triangle)}} = \frac{1}{2} \times b \times h$$

$$= \frac{1}{2} \times \underline{\hspace{2cm}} \times \underline{\hspace{2cm}}$$

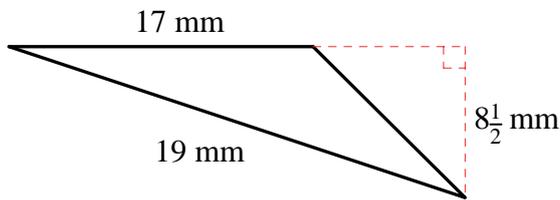
$$= \underline{\hspace{2cm}}$$

∴ The area is $\underline{\hspace{2cm}}$ km².

(b)



(c) Not all measurements are needed so choose carefully!



What did the square say to the little triangle?



You're acute one!!!

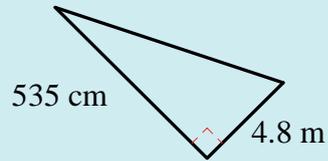


Check your work before continuing.

Skills development 6.2

Example

Find the area in square metres for the following triangle.



Solution

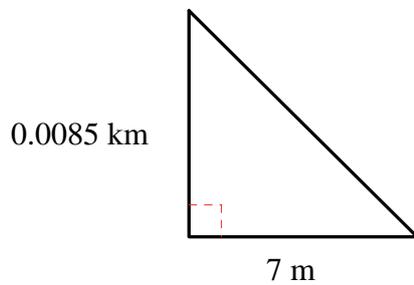
$$535 \div 100 = 5.35$$

$$\begin{aligned} A_{\text{(triangle)}} &= \frac{1}{2} \times b \times h \\ &= \frac{1}{2} \times 4.8 \times 5.35 \\ &= 12.84 \end{aligned}$$

\therefore The area of the rectangle is 12.84 m^2 .

1. Determine the area for each of the following triangles.

(a)

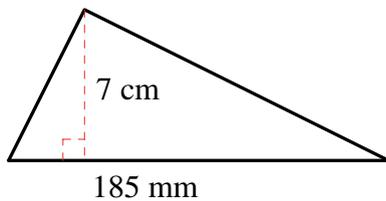


$$0.0085 \times 1000 = \underline{\hspace{2cm}}$$

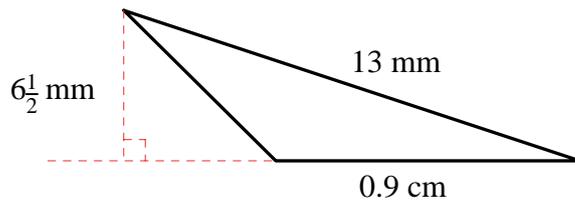
$$\begin{aligned} A_{\text{(triangle)}} &= \frac{1}{2} \times b \times h \\ &= \frac{1}{2} \times \underline{\hspace{2cm}} \times \underline{\hspace{2cm}} \\ &= \underline{\hspace{2cm}} \end{aligned}$$

\therefore The area is $\underline{\hspace{2cm}} \text{ m}^2$.

(b)



(c) Not all measurements are needed so choose carefully!





Check your work before continuing.

7. Solving area problems

When you complete this section you should be able to:

- use formulas for area of rectangles, triangles and parallelograms to solve problems.

Warm-up 7

1. $845 \div 10 =$ _____

2. $14 \times 7 =$ _____

3. The temperature is 2 degrees.

How much will it need to decrease to get to minus 3 degrees? _____

4. $\frac{1}{2} + \frac{1}{4} =$ _____

5. $\frac{1}{5} \times 45 =$ _____

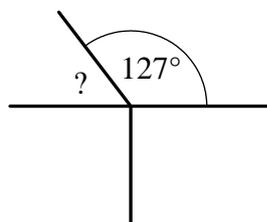
6. $4000 \text{ mL} =$ _____ L

7. $10 \div 5 + 5 =$ _____

8. Find 10% of \$84. _____

9. Describe the rule for the following pattern. 2, 4, 6, 8, 10, ...

10.

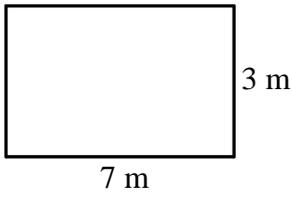


Determine the size of the missing angle. _____

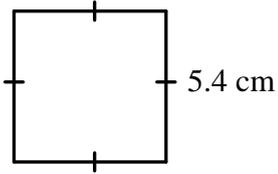
Review 7.1

1. Determine the area for the following shapes.

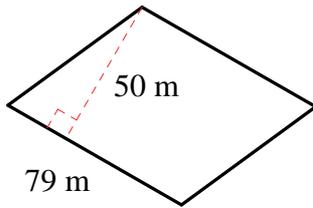
(a)



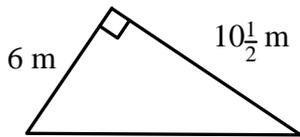
(b)



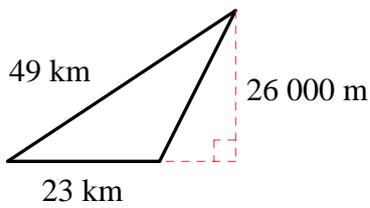
(c)



(d)



(e) Watch out for this one!



Review 7.2

Example

It costs \$25.50 per square metre to pave some lawn.

How much in total will it cost to pave 30 m^2 of lawn?

Solution

This problem uses multiplication to solve it.

$$25.50 \times 30 = 765$$

\therefore It will cost \$765 to pave the lawn.

- It costs \$16.50 per square metre for wall tiles.
By completing the following, determine how much will it cost to tile 25 m^2 .

$$\underline{\hspace{2cm}} \times \underline{\hspace{2cm}} = \underline{\hspace{2cm}}$$

\therefore It will cost \$ to tile 25 m^2 .

- It costs \$55 per square metre for carpet.
What is the total cost of carpet for a 36 m^2 room?

- A wall has an area of 45.5 m^2 .
How much will it cost to cover if wallpaper is \$23.50 per square metre?

Review 7.3

Example

A shed wall has an area of 36 m^2 .

How many tins of paint are needed if each tin covers 15 m^2 ?

Solution

This problem uses division to solve it.

$$36 \div 15 = 2.4$$

\therefore 3 tins of paint are required.

Note how the answer has been rounded up. (Two tins of paint would not cover the wall.)

1. A basketball court with an area of 440 m^2 needs to be repainted. A tin of paint will cover 64 m^2 .
How many tins of paint are required to paint the whole court?

$$\underline{\hspace{2cm}} \div \underline{\hspace{2cm}} = \underline{\hspace{2cm}}$$

\therefore tins of paint are required..

2. The area of a fence is 120 m^2 .
How many tins of paint are needed if each tin covers 32 m^2 ?

3. A 2 kg packet of fertilizer will cover 80 m^2 of grass. If a lawn is 470 m^2 , how many packets of fertilizer are needed?



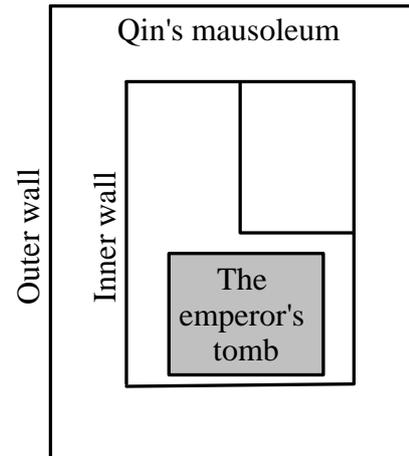
Check your work before continuing.

Focus problem 7

Sometimes referred to as the 'City of Death', the Chinese Emperor Qin's mausoleum precinct was built around 2300 years ago.

A rectangular section 4 metres by 15 metres is to be repaved. The pavers cost 90 yuan (Chinese currency) per square metre.

How much in total will it cost for the pavers?



Check your work before continuing.

Qin's terracotta army

In 1974, some farmers discovered a terracotta army some 600 metres from Emperor Qin's mausoleum. Some 8000 life-sized soldiers, together with 700 horses and 130 chariots, were discovered. It is believed that they were made to protect Qin's empire on his passing into the afterlife.

Skills development 7.1

Example

Martin has an area of lawn that he would like to pave. The lawn is rectangular in shape measuring 4 metres by 8 metres. Martin located on the internet some cheap pavers for \$12.50 per m^2 .

How much will it cost Martin to pave his lawn?

Solution



8 m

4 m



It will help you to draw a diagram and label the shape.

$$\begin{aligned} A_{\text{(rectangle)}} &= l \times w \\ &= 4 \times 8 \\ &= 32 \end{aligned}$$

\therefore The area of the rectangle is 32 m^2 .

$$32 \times \$12.50 = 400$$

\therefore It will cost Martin at least \$400.

But why does it say 'at least'?



Sometimes the shape of the pavers might not fit the shape you need covering.

In addition, when you are laying pavers and tiles, some will often break, so it is wise to order more than you need.

1. Caitlyn wants to tile a wall in her house. The wall is 2.4 metres by 3 metres and the tiles cost \$25 per square metre.

(a) Draw a rectangle and label the dimensions to represent the wall.

(b) Determine the area of the rectangle.

(c) Determine the cost of the tiles for the wall. That is, multiply the area by the cost per square metre.

2. As part of the local art and craft show, Phil needs to paint a parallelogram with a base of 13 metres and a perpendicular height of 3.5 metres. A tin of paint covers 32 m^2 .

(a) Draw a diagram and show all the dimensions of the parallelogram.

(b) Determine the area that is to be painted.

(c) Determine the number of tins of paint needed. That is, divide the area by 32 and round up.

3. Sunny is fertilising her triangular patch of lawn. The length of the base is 5 metres and the perpendicular height is 6 metres. According to the fertiliser package, Sunny requires 20 grams per square metre.

How much fertiliser will Sunny need?

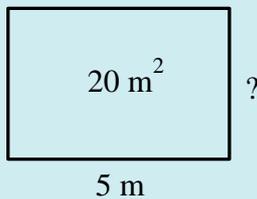
Skills development 7.2

Example

A rectangle has an area of 20 m^2 and a length of 5 m.

What is its width?

Solution



$$A_{\text{(rectangle)}} = l \times w$$

$$20 = 5 \times w$$

$$20 = 5 \times 4$$

$$\therefore w = 4$$

The width of the rectangle is 4 m.



Guess and check can be used to find your answer.

Or perhaps you can find another way?

1. A rectangle has an area of 36 mm^2 and its length is 4 mm.
What is its width?

(a) Draw a diagram.

(b) $A_{\text{(rectangle)}} = l \times w$

$$\underline{\hspace{2cm}} = \underline{\hspace{2cm}} \times w$$

$$36 = 4 \times \underline{\hspace{2cm}}$$

$$\therefore w = \underline{\hspace{2cm}}$$



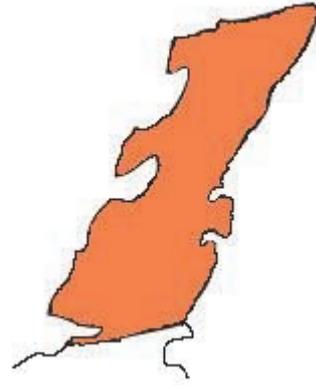
Remember that you
can use a calculator
if you need to.

The width of the rectangle is _____ mm.

2. A parallelogram has a height of 7 m and an area of 35 m^2 .
What is the length of its base?

3. Murujuga is situated 1550 km north of Perth, near Dampier and is more commonly known as the Burrup Peninsula. Its shape closely resembles a parallelogram.

If the perpendicular height is 6 km and its area is 117 km^2 , how long is Murujuga?





Check your work before continuing.

Industrialisation versus conservation

Murujuga is home to Australia's largest rock carving collection, containing hundreds of thousands of Aboriginal petroglyphs dating back to at least 10 000 years ago. Some of the artworks depict animals that are now extinct, including the thylacine (Tasmanian tiger).

In 1868, the site was the scene of a very violent battle between early European settlers and its traditional owners, the Jaburara people. Many of the traditional owners were massacred. These days the battle is now between industrialisation and conservation. Commercial activities are impacting on the pristine environment and national heritage is being destroyed.

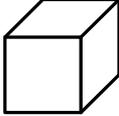
8. Summary

- A 'dimension' refers to length, width and height.

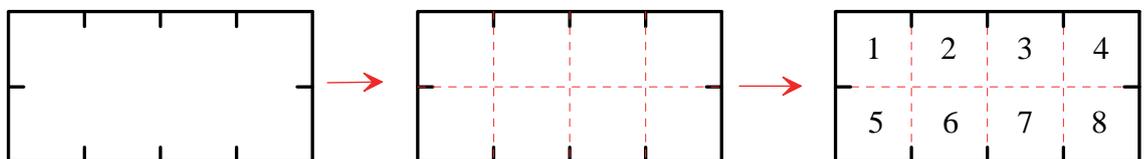
For example:

 A line has one dimension (typically length).

 A rectangle has two dimensions (typically length and width).

 A cube has three dimensions (typically length, width and height).
(Although this is only a two-dimensional representation.)

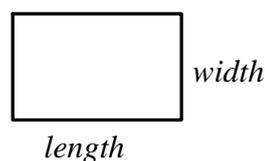
- Perimeter is the distance around the outside of a two-dimensional shape. To find the perimeter of a shape, add together its side lengths.
- Area is the amount of material needed to 'cover' a surface. To find the area of a shape, divide the shape up into equal parts (generally square units) and then count them.



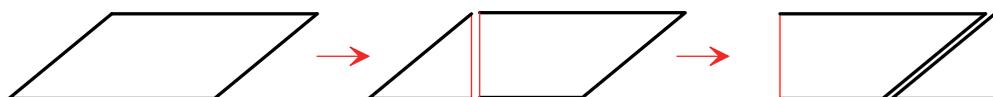
- The following is a formula for finding the area of rectangles.

$$\text{Area}_{(\text{rectangle})} = l \times w \quad \text{where } l \text{ represents length}$$

$$w \text{ represents width}$$



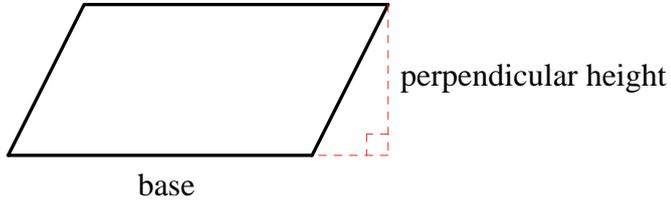
- A parallelogram can be made into a rectangle.



- The following is a formula for finding the area of parallelograms.

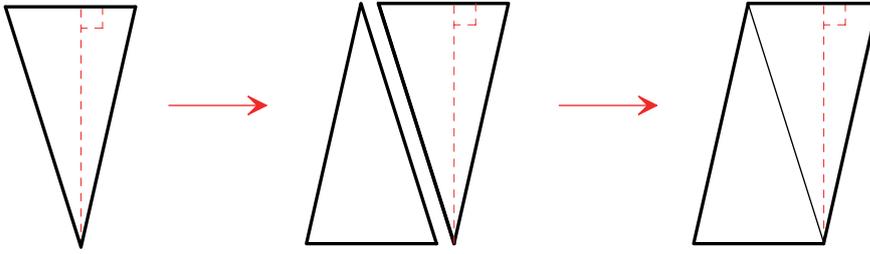
$$\text{Area}_{(\text{parallelogram})} = b \times h \quad \text{where } b \text{ is the base}$$

$$h \text{ is the perpendicular height}$$



Note that any side can be considered as the base.

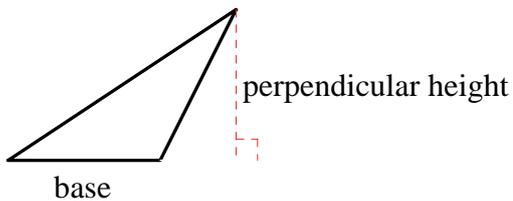
- The area of a triangle is half that of a parallelogram.



- The following is a formula for finding the area of triangles.

$$\text{Area}_{(\text{triangle})} = \frac{1}{2} \times b \times h \quad \text{where } b \text{ is the base}$$

$$h \text{ is the perpendicular height}$$



Note that any side can be considered as the base.

9. Review tasks

The following tasks will assist you to consolidate your learning and understanding of the concepts introduced in this resource, and assist you to prepare for assessments.

Task A

Name: _____

Suggested time: 45 minutes

Actual time taken: _____

Instructions:

Complete this work on your own.

You may use a calculator, but show how you got your answer.

Attempt every question. Take as long as you need and record the time in the space provided above after you have finished.

1. Explain in your own words each of the following terms.

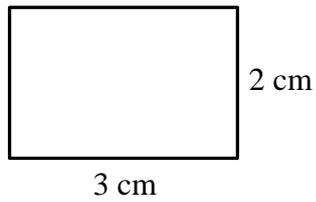
(a) perimeter _____

(b) area _____

(c) dimension _____

(d) perpendicular height _____

2. The following rectangle has an area of 6 cm^2 .



- (a) Draw squares on the shape above to show this is true.

The formula for finding the area of a rectangle is given as:

$$\text{Area}_{(\text{rectangle})} = l \times w$$

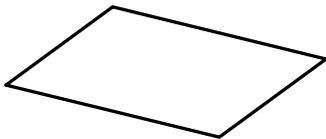
where l represents length
 w represents width.

- (b) Explain why the formula works.

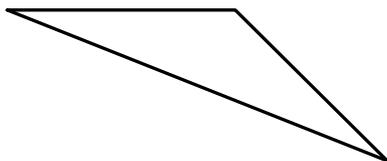
Hint: Use the rectangle above to help with your explanation.

3. For each of the following shapes, mark in the base and perpendicular height.

- (a)

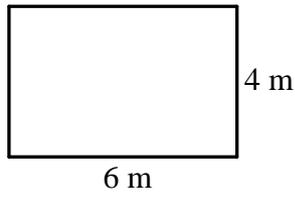


- (b)

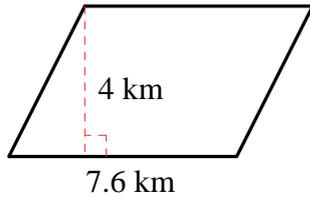


4. Determine the area for each of the following shapes.

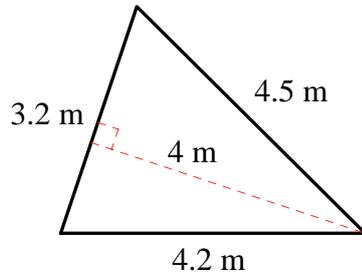
(a)



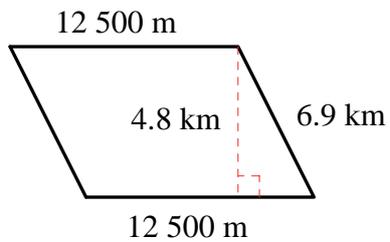
(b)



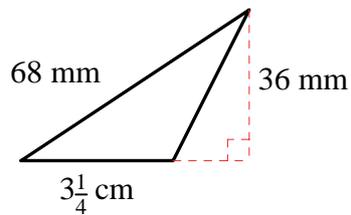
(c)



(d)



(e)



5. Leroy is tiling his bathroom floor. The floor is rectangular with a length of 3 metres and a width of 2.4 metres.

(a) Draw a diagram.

(b) Determine the area of the bathroom floor.

(c) If there are 20 tiles in a square metre, how many tiles will Leroy need?

6. Trina's company holds an exploration licence over some land. She wishes to extend the licence for another year and finds that it costs \$600 per square kilometre. The land is in the shape of a triangle, with a base of 46 km and a perpendicular height of 23 km.

How much will it cost Trina's company to extend the licence?

7. The local football competition is sponsored by a media network. The managing director of the network wants its logo painted onto the playing field. The logo is a combination of two identical parallelograms. The managing director wants each parallelogram to have a base of 20 metres and a perpendicular height of 15 metres.

(a) Determine the area of one of the parallelograms?

(b) What is the combined area of the two parallelograms?

A litre of paint covers 8 square metres and costs \$45.

(c) How many litres of paint are required?

(d) What is the total cost for the paint?

Task B

Name: _____

Suggested time: 30 minutes

Actual time taken: _____

Instructions:

Complete this work on your own.

You may use a calculator but show how you got your answer.

Attempt every question. Take as long as you need and record the time in the space provided below after you have finished.

Wild dogs had been attacking Kira's emus so Kira decided to pen in the birds. Kira had 90 metres of fencing to use.



At first Kira planned to build a rectangular pen measuring 1 m by 90 m.

1. Will Kira have enough fencing to build the pen? Give reasons for your answer.

Kira revised her plan and decided on a 1 m by 44 m rectangular pen.

2. (a) What would be the perimeter of Kira's new pen?

- (b) What would be its area?

Kira's cousin, Nathan, suggested that Kira should build a rectangular pen that gives the emus more room to move. He suggested using a length of 10 metres.

3. (a) How wide could Kira make her pen if its length is 10 metres?

- (b) What would be the area for this rectangular pen?

Kira wondered what sized rectangular pen would give the largest area.

4. Complete the table.

Pen	dimensions		Perimeter (m)	Area (m ²)
	length	width		
1	10		90	
2	15		90	
3	20			500
4		22.5	90	

5. (a) What are the dimensions of the rectangular pen that has the largest area?

- (b) Describe its shape.

Kira wondered if a triangular pen would have the greatest area. She used a triangle with all three sides measuring 30 metres. Kira found its perpendicular height was approximately 26 metres.

6. Determine the area of the triangular pen.

7. In what shape should Kira build the pen? Give your reasons.

Self-evaluation task

Please complete the following.

How well did you manage your own learning using this resource?

	Always	Usually	Rarely	Not sure
Each section took approximately 45 minutes to complete.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
I needed extra help.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
I marked and corrected my work at the end of each section.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
I made the journal entries and summaries when asked.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
I have kept to my work schedule.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

How much mathematics have you learnt using this resource?

	Always	Usually	Rarely	Not sure
<i>Understanding</i>				
I understand the differences between perimeter and area immediately.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<i>Fluency</i>				
I can recall the rules for the area of triangles and parallelograms.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
I calculated accurately.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
I know how to use these rules, including how to choose the correct measurements and units.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
I calculated areas of triangles.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
I included correct units in my answers.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<i>Problem Solving</i>				
I could draw diagrams with labelled dimensions, representing information from word problems.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
I solved problems involving area.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
I chose the correct area formulas to use when solving problems.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<i>Reasoning</i>				
I can explain why the area rules work.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Write a list of topics for which you need additional assistance.				

Solutions

1. Perimeter and area review

Solutions to Warm-up 1

1. 4 is the only factor of eight.
2. 12
3. $a = (-3)$
4. $\frac{2}{3}$
5. 9
6. 3.8
7. 21
8. $\frac{1}{10}$
9. 100
10. (1, 2)

Solutions to Review 1.1

1. (a) $Perimeter = 9 + 2 + 9 + 2$
 $= 22$
 \therefore The perimeter is 22 cm.

- (b) 29 km
- (c) 17.2 mm



Make sure you show your working and include the units in your answer, like that in part 1(a).

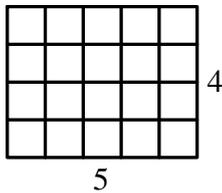
Solutions to Review 1.2

1. (a) 10 square units
 (b) 15 square units
 (c) 12 square units

Solution to Focus problem 1

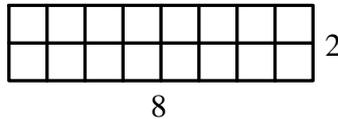
What you were asked to do was to determine if a rectangle with a smaller perimeter can have a larger area.

Rectangle A



$$\begin{aligned} \text{Area} &= 20 \text{ square units} \\ \text{Perimeter} &= 4 + 5 + 4 + 5 \\ &= 18 \text{ units} \end{aligned}$$

Rectangle B



$$\begin{aligned} \text{Area} &= 16 \text{ square units} \\ \text{Perimeter} &= 8 + 2 + 8 + 2 \\ &= 20 \text{ units} \end{aligned}$$

The area for the Rectangle A is larger than Rectangle B, however the perimeter is smaller, which means that Seiko was correct.

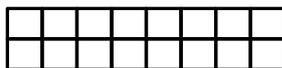
Solutions to Investigation 1

- As it's only an opinion, at this point there are no wrong or right answers.
-

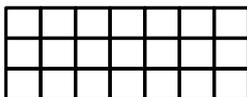
9 by 1



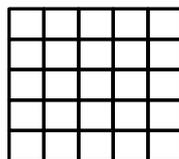
8 by 2



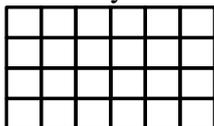
7 by 3



5 by 5



6 by 4



-
-
-

Chocolate bars	dimensions		Perimeter (cm)	Area (cm ²)
	length	width		
1	1	9	20	9
2	2	8	20	16
3	3	7	20	21
4	4	6	20	24
5	5	5	20	25

- Solutions may vary.
For example:
The length and width of each bar adds to 10.
The greatest area is the square.

5. (a) A square chocolate bar, 6 cm by 6 cm
(b) $6 \times 6 = 36 \text{ cm}^2$
6. Solutions may vary. For example:
(a) Perimeter is the distance around the outside of a shape.
(b) Area is the amount of material needed to cover a surface.
(c) Dimension is the length, width or height.

2. Area of rectangles

Solutions to Warm-up 2

- 6 is the common factor of 24 and 30.
- 6
- (-5 degrees)
- $\frac{2}{3} < \frac{3}{4}$
- 6
- 3
- 2.4
- 0.5
- 0.7
- The prime numbers are 2, 3 and 5.
 \therefore The probability of a prime number is 50%.

Solutions to Review 2.1

- (a) 12 cm^2
(b) 18 cm^2
(c) 8 cm^2

Solutions to Review 2.2

- (a) 17.5 cm^2
(b) 12.75 cm^2

Solutions to Review 2.3

- (a) 6500 m
(b) 7.31 m
(c) 2.8 cm
(d) 360 mm
(e) 8.4 km
(f) 4.8 m
(g) 352 cm
(h) 210 000 cm

Solution to Focus problem 2

What you were asked to find was the area of a rectangle.

You can find the area in three different ways.

You could:

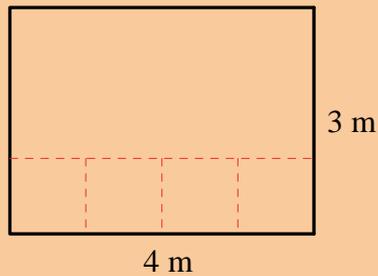
1. Divide the shape into square units and then count the squares.
2. Determine the number of squares in one row and multiply it by the number of rows.
3. Use the formula for finding the area.

$$\text{Area}_{\text{ (rectangle)}} = \text{length} \times \text{width}$$

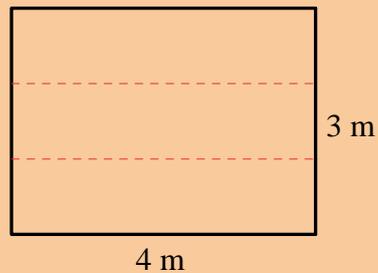
Formula for an area of a rectangle – Where does it come from?

Let's look at the 4 m by 3 m floor.

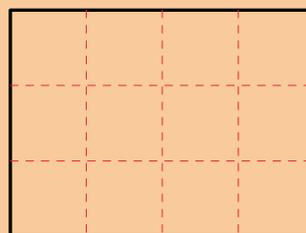
A length of 4 metres means that there are four squares across.



A width of 3 metres means that there are 3 rows.



So we have 3 rows of 4 squares.



This gives us $3 \times 4 = 12$ square units.

That is, if we multiply the length by the width we will find the area.

Algebraic representation

To reduce time, the formula for the area of a rectangle can be written algebraically.

Given the formula:

$$Area_{\text{ (rectangle)}} = length \times width$$

Algebraically, it is:

$$A_{\text{ (rectangle)}} = l \times w \quad \text{where } A \text{ represents the area}$$

$$l \text{ represents length}$$

$$w \text{ represents width.}$$

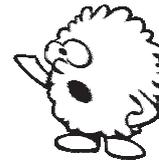
Using the formula for finding the area of a rectangle, we have:

$$\begin{aligned} A_{\text{ (rectangle)}} &= l \times w \\ &= 4 \times 3 \\ &= 12 \end{aligned}$$

\therefore The area of the rectangle is 12 m^2 .

So Soma will need at least 12 m^2 of carpet for his room.

Note that the units are called 'square metres' and are written as m^2 .



Note that the shape of the carpet may not exactly fit the room and an often part of it is wasted in the fitting process. That is why the solution states 'at least', as this is the minimum amount required without taking into consideration of wastage.

Solutions to Skills development 2.1

$$\begin{aligned} 1. \quad (a) \quad A_{\text{ (rectangle)}} &= l \times w \\ &= 6 \times 8 \\ &= 48 \end{aligned}$$

\therefore The area of the rectangle is 48 m^2 .

- (b) 150 mm^2
- (c) 144 mm^2
- (d) 20 cm^2
- (e) 34 km^2
- (f) 671.24 m^2

Make sure you show your working and include the units in your answer, like that in part 1(a).



2. Solutions may vary slightly. For example, a formula is a mathematical statement which can be used to solve a problem.

Solutions to Skills development 2.2

$$\begin{aligned}
 1. \quad (a) \quad & 350 \div 100 = 3.5 \text{ m} \\
 & A_{\text{(rectangle)}} = l \times w \\
 & = 6 \times 3.5 \\
 & = 21
 \end{aligned}$$

\therefore The area of the rectangle is 21 m^2 .

$$(b) \quad 21.06 \text{ cm}^2 \text{ or } 2106 \text{ mm}^2$$

$$(c) \quad 23.375 \text{ m}^2 \text{ or } 23\frac{3}{8} \text{ m}^2 \text{ or } 23\,375\,000 \text{ mm}^2$$

You may like to ask your teacher for some more examples to further develop your fluency.



How do you convert units of area?



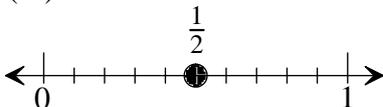
You will find that out next year. However, see if you can work it out for yourself.



3. Parallelogram area formula

Solutions to Warm-up 3

- 2, 3 and 5 are prime numbers.
- 54
- $a = (-2)$
-



- $12 \div 3 = 4$
- $5 + 5 = 10$
- 7.7
- 50%
- $\frac{4}{4}$ or 1
- Square (or rectangle)

Solutions to Focus problem 3

What you were asked to find was the area of a parallelogram.

This could be achieved in at least three ways:

1. Counting the squares (joining part squares together to make whole squares).
2. Cutting the shape up and repositioning the parts to make it into a rectangle.
3. Using the formula for finding the area of parallelograms.

$$Area_{\text{ (parallelogram)}} = \textit{base} \times \textit{perpendicular height}$$

Or algebraically: $A_{\text{ (parallelogram)}} = b \times h$

Using the formula to solve Eugene's problem:

$$\begin{aligned} A_{\text{ (parallelogram)}} &= b \times h \\ &= 50 \times 20 \\ &= 1000 \end{aligned}$$

\therefore The area for sale is 1000 m².

Note the units are called 'square metres', written as m².



But where does the formula for a parallelogram come from?



Go back and do the next investigation to find out!

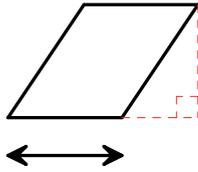
Solutions to Skills development 3

1. Solutions may vary.

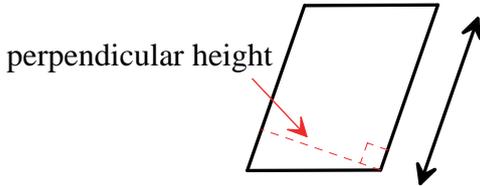
(a) perpendicular height



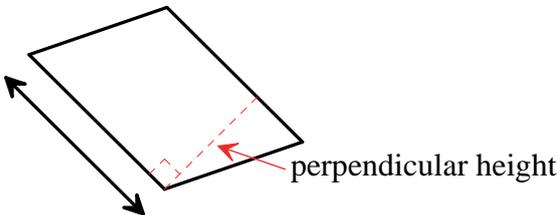
(b) perpendicular height



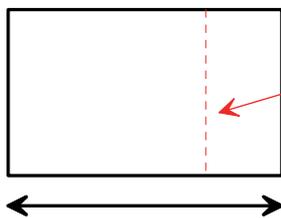
(c) perpendicular height



(d) perpendicular height



(e) perpendicular height



Solutions to Investigation 3

Part 1

1 – 2. No solutions are required.

3. Rectangle

4. Solutions will vary and depend on size of measurements.

For example, if the length is 200 mm and the width is 100 mm then the area becomes:

$$\begin{aligned} \text{Area}_{(\text{rectangle})} &= 200 \times 100 \\ &= 20\,000 \text{ mm}^2 \text{ (or } 200 \text{ cm}^2\text{)}. \end{aligned}$$

5. No solution is required.

6. As it's only an opinion there are no wrong or right answers.

7. No solution is required.

8. Parallelogram

9. No solution is required.

10. Rectangle

11. Solutions will vary and depend on size of measurements.

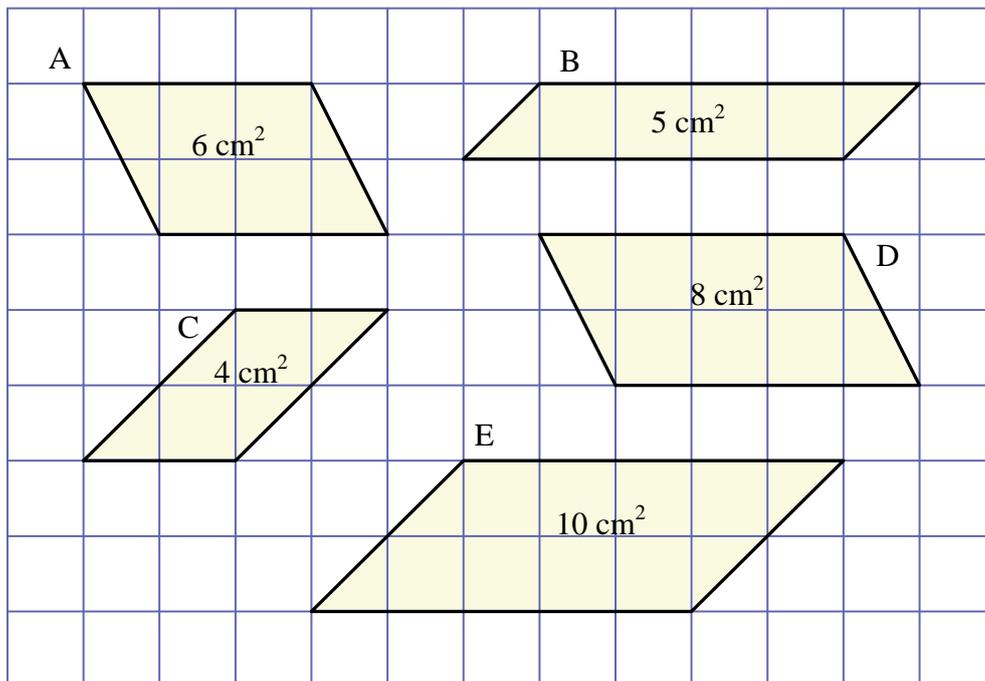
For example, if the length is 200 mm and the width is 100 mm then the area becomes:

$$\begin{aligned} \text{Area}_{(\text{rectangle})} &= 200 \times 100 \\ &= 20\,000 \text{ mm}^2 \text{ (or } 200 \text{ cm}^2\text{)}. \end{aligned}$$

12. Answers for parts 4 and 11 should be the same depending on accuracy of measurements taken.

Part 2

1.



2.

Parallelograms	base (b)	perpendicular height (h)	Area (A)
A	3 cm	2 cm	6 cm^2
B	5 cm	1 cm	5 cm^2
C	2 cm	2 cm	4 cm^2
D	4 cm	2 cm	8 cm^2
E	5 cm	2 cm	10 cm^2

3. $\text{Area}_{(\text{parallelogram})} = \text{base} \times \text{perpendicular height}$

4. Area of parallelograms

Solutions to Warm-up 4

- The first 5 prime numbers are: 2, 3, 5, 7, 11.
- 6
- 2 degrees
- $w = \frac{3}{10}$
- 5
- 2.98
- 2.71
- $\frac{25}{100} = \frac{1}{4}$
- 29
- $180 - 61 = 119$
 $\therefore 119^\circ$

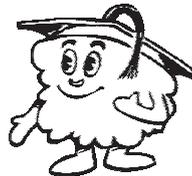
Solutions to Review 4

$$\begin{aligned}
 1. \quad (a) \quad A_{(\text{rectangle})} &= l \times w \\
 &= 7 \times 3 \\
 &= 21
 \end{aligned}$$

\therefore The area of the rectangle is 21 km^2 .

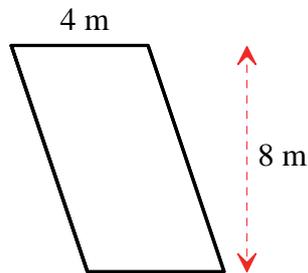
- 51.84 m^2
- 45 mm^2

Make sure you show your working and include the units in your answer, like that in part 1(a).



Solutions to Focus problem 4

What you were asked to find was the area of a parallelogram with a base of 4 metres and a perpendicular height of 8 metres, as shown below.



Using the formula for finding the area of parallelograms:

$$\begin{aligned} A_{\text{(parallelogram)}} &= \text{base} \times \text{perpendicular height} \\ &= 4 \times 8 \\ &= 32 \end{aligned}$$

\therefore The area is 32 m^2 .

But what does
'perpendicular height'
mean?



Solutions to Skills development 4.1

$$\begin{aligned} 1. \quad (a) \quad A_{\text{(parallelogram)}} &= b \times h \\ &= 7 \times 4 \\ &= 28 \end{aligned}$$

\therefore The area is 28 m^2 .

(b) 42.4 km^2

(c) $18\frac{3}{4} \text{ km}^2$ or 18.75 km^2

Make sure you show your
working and include the
units in your answer, like
that in Part 1.



Solutions to Skills development 4.2

1. (a) $0.35 \times 1000 = 350 \text{ m}$

$$\begin{aligned} A_{\text{(parallelogram)}} &= b \times h \\ &= 640 \times 350 \\ &= 224\,000 \end{aligned}$$

\therefore The area is $224\,000 \text{ m}^2$.

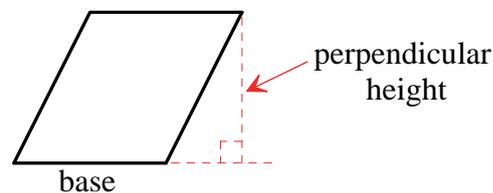
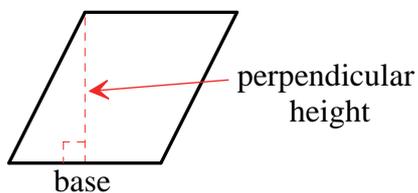
(b) $29\frac{1}{4} \text{ cm}^2$ or 29.25 cm^2 or 2925 mm^2



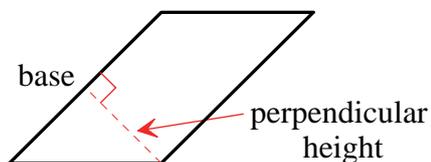
Make sure you show your working and include the units in your answer, like that in part (a).

2. Solutions may vary.

(a) For example, perpendicular height refers to the distance between the base and the top (apex).

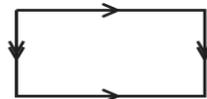


Note that the base can be any chosen side.



(b) A parallelogram is a four-sided shape (quadrilateral) with opposite sides parallel. That is, the opposite sides do not intersect.

For example:



3. Solutions will vary. Please check your results with an adult.

5. The area of triangle formula

Solutions to Warm-up 5

1. The first 5 square numbers are: 1, 4, 9, 16, 25.
2. 32
3. $k = (-10)$
4. $\frac{3}{4}$
5. $16 \div 4 = 4$
6. 42 mm
7. 27
8. 3.5
9. 1.9
10. (3, 1)

Solution to Focus problem 5

What you were asked to find was the area of a triangle.

Using the formula for finding the area of triangles:

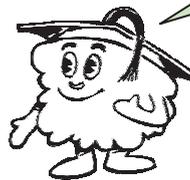
$$\begin{aligned}
 A_{\text{(triangle)}} &= \frac{1}{2} \times \text{base} \times \text{perpendicular height} \\
 &= \frac{1}{2} \times 29 \times 56.5 \\
 &= 819.25
 \end{aligned}$$

\therefore The area is 819 m².

But where does the formula come from?

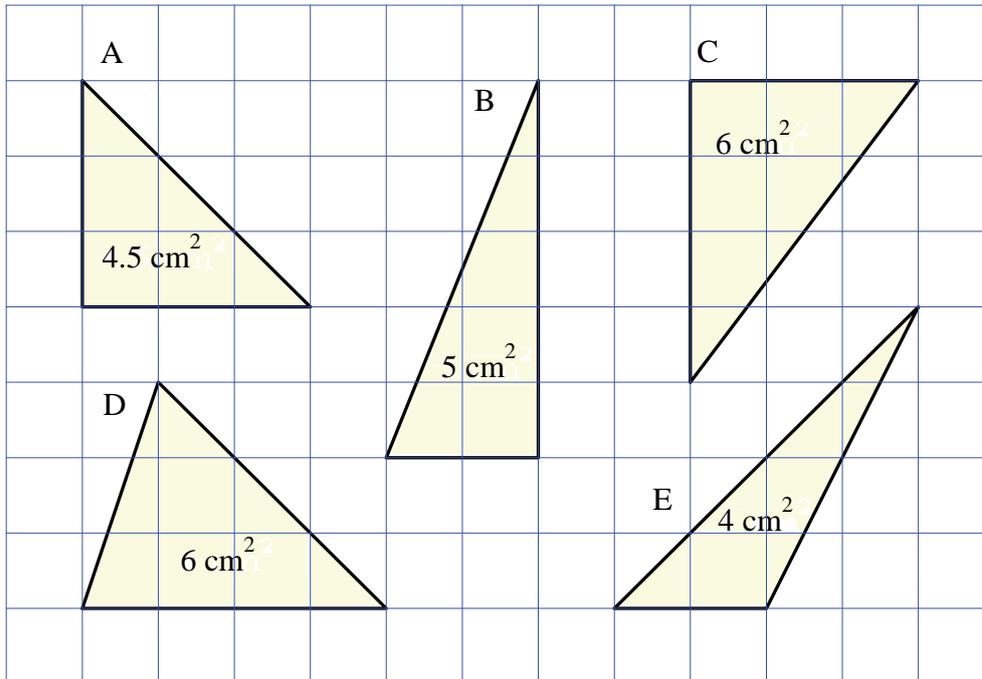


Keep working to find out!



Solutions to Investigation 5

1. Depending on accuracy, solutions may vary.



2. Depending on accuracy, solutions may vary.

Triangles	base (b)	perpendicular height (h)	Area (A)
A	3 cm	3 cm	4.5 cm^2
B	2 cm	5 cm	5 cm^2
C	3 cm	4 cm	6 cm^2
D	4 cm	3 cm	6 cm^2
E	2 cm	4 cm	4 cm^2

3. $\text{Area}_{(\text{triangle})} = \frac{1}{2} \times \text{base} \times \text{perpendicular height}$

Solutions to Activity 5.1

Part 1

- 1–5. Solutions will vary.
 6. The shape should be a triangle.
 7. Solutions will vary.
 8. The area found in part 7 should be half the area found in part 2.

Solutions to Activity 5.2

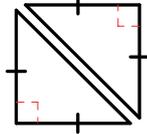
Hi-tech activity

- 1–5. Solutions will vary.
6. The shape should be a parallelogram. Note that rectangles and squares are special types of parallelograms.
7. Solutions will vary.
8. Right triangles will form rectangles.
For example:



Isosceles right triangles will form squares.

For example:



Low-tech activity

- 1–5. Solutions will vary.
6. See part 8 in the above solutions for the hi-tech activity.

Parallel puzzle?

A and B are the same length.

6. Area of triangles

Solutions to Warm-up 6

1. 98
2. 5
3. 5 degrees
4. $\frac{2}{6} = \frac{1}{3}$
5. 3
6. 8000 g
7. 15
8. 25%
9. $\frac{2}{4}$ or $\frac{1}{2}$
10. $P(1 \text{ or } 2) = \frac{2}{3}$

Solution to Focus problem 6

What you were asked to find was the area of a triangle to see if the paint would cover it. Using the formula for finding the area of triangles:

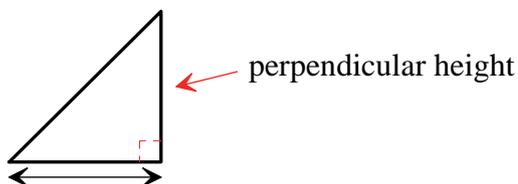
$$\begin{aligned} A_{(\text{triangle})} &= \frac{1}{2} \times \text{base} \times \text{perpendicular height} \\ &= \frac{1}{2} \times 10 \times 3 \\ &= 15 \end{aligned}$$

\therefore The area is 15 m^2 so Tahiti will not need to buy any more paint.

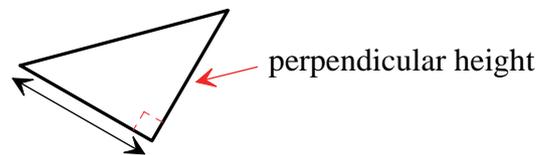
Solutions to Skills development 6.1

1. (a) Solutions may vary. For example, perpendicular height is the distance between the top and the base. It is represented by a line at right angles (90°) to the base.

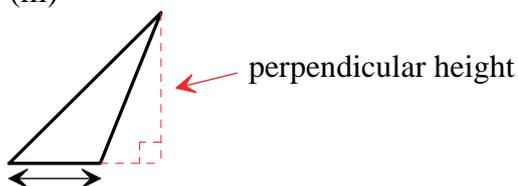
(b) (i)



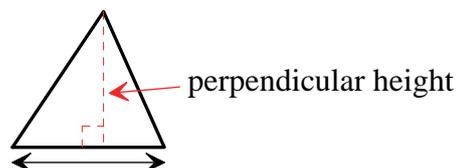
(ii)



(iii)



(iv)



2. (a) $A_{\text{(triangle)}} = \frac{1}{2} \times b \times h$
 $= \frac{1}{2} \times 5 \times 6$
 $= 15$
 \therefore The area is 15 km^2
- (b) 4.32 m^2
- (c) $72\frac{1}{4} \text{ mm}^2$ or 72.25 mm^2

Solutions to Skills development 6.2

1. (a) $0.0085 \times 1000 = 8.5$
 $A_{\text{(triangle)}} = \frac{1}{2} \times b \times h$
 $= \frac{1}{2} \times 7 \times 8.5$
 $= 29.75$
 \therefore The area is 29.75 m^2
- (b) 64.75 cm^2 or 6475 mm^2
- (c) 0.2925 cm^2 or 29.25 mm^2

7. Solving area problems

Solutions to Warm-up 7

- 84.5
- 98
- 5 degrees
- $\frac{2}{4} + \frac{1}{4} = \frac{3}{4}$
- 9
- 4 L
- 7
- \$8.40
- Adding two each time.
- $180 - 127 = 53$
 $\therefore 53^\circ$

Solutions to Review 7.1

- $$A_{\text{(rectangle)}} = 7 \times 3$$

$$= 21$$

\therefore The area is 21 m^2
 - 29.16 cm^2 or 29.2 cm^2 (1dp)
 - 3950 m^2
 - $$A_{\text{(triangle)}} = \frac{1}{2} \times 6 \times 10 \frac{1}{2}$$

$$= 31 \frac{1}{2} \text{ or } 31.5$$

\therefore The area is 31.5 m^2 .
 - 299 km^2 or $299\,000\,000 \text{ m}^2$

Solutions to Review 7.2

- $25 \times 16.50 = 412.5$
 \therefore It will cost \$412.50 to tile 25 m^2 .
- $36 \times 55 = 1980$
 \therefore It will cost \$1980 to carpet 36 m^2 .
- \$1069.25

Solutions to Review 7.3

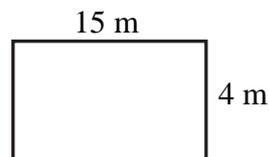
- $440 \div 64 = 6.875$
 \therefore 7 tins of paint are required.
- $120 \div 32 = 3.75$
 \therefore 4 tins of paint are required.
- 6 packets

There are many ways to solve these problems. Just remember to show your working.



Solution to Focus problem 7

What you were asked to find was the cost of the pavers. However, before you can do that you must find the area of the following rectangle.



Using the formula for finding the area of rectangles:

$$\begin{aligned} A_{\text{(rectangles)}} &= \text{length} \times \text{width} \\ &= 15 \times 4 \\ &= 60 \end{aligned}$$

$$60 \times 90 = 5\,400$$

\therefore The total cost of the pavers is 5400 yuan.

Solutions to Skills development 7.1

- (a)

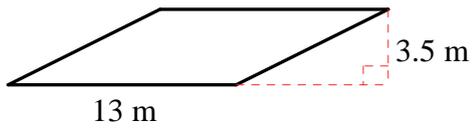
$$\begin{aligned} \text{(b) } A_{\text{(rectangle)}} &= 3 \times 2.4 \\ &= 7.2 \\ \therefore \text{The area is } &7.2 \text{ m}^2 \end{aligned}$$

$$\begin{aligned} \text{(c) } 7.2 \times 25 &= 180 \\ \therefore \text{The cost of the tiles is } &\$180. \end{aligned}$$

The Chinese currency is a yuan (pronounced yoo-aan). It takes roughly six yuans to equal one Australia dollar.



2. (a)



$$\begin{aligned} \text{(b) } A_{\text{(parallelogram)}} &= 13 \times 3.5 \\ &= 45.5 \end{aligned}$$

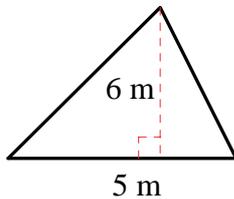
\therefore The area to be painted is 45.5 m^2 .

$$\text{(c) } 45.5 \div 32 = 1.421875 \text{ or } 2 \text{ (rounded up)}$$

\therefore Two tins of paint are required.

Remember, drawing a diagram will help you solve your problem.

3.



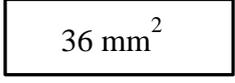
$$\begin{aligned} A_{\text{(triangle)}} &= \frac{1}{2} \times 5 \times 6 \\ &= 15 \end{aligned}$$

\therefore The area is 15 m^2

$$15 \times 20 = 300$$

\therefore The amount of fertiliser Sunny needs is 300 grams.

Solutions to Skills development 7.2

1. (a)  $w = ?$
4 mm

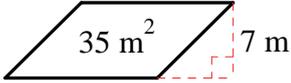


Your drawing is only there to help you. It does not have to be perfect.

(b) $A_{\text{(rectangle)}} = l \times w$
 $36 = 4 \times w$
 $36 = 4 \times 9$
 $\therefore w = 9$

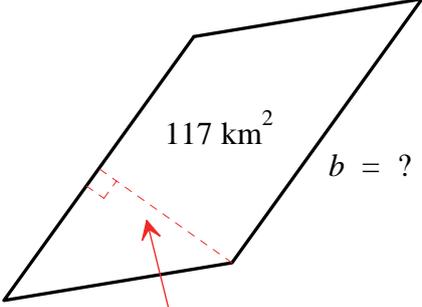
\therefore The width of the rectangle is 9 mm.

In this case, the smaller side turns out to be the longest. However, there is no need to fix up your drawing as it is only a sketch.

2.  $b = ?$

$A_{\text{(parallelogram)}} = b \times h$
 $35 = b \times 7$
 $35 = 5 \times 7$
 $\therefore b = 5$

\therefore The length of the base of the parallelogram is 5 m.

3.  $b = ?$
6 km

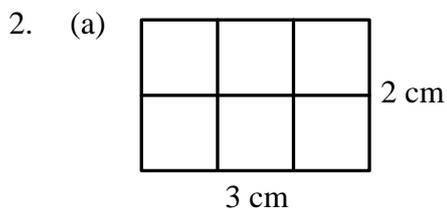
$A_{\text{(parallelogram)}} = b \times h$
 $117 = b \times 6$
 $117 = 19.5 \times 6$
 $\therefore b = 19.5$

\therefore The length of Murujuga is 19.5 km.

9. Solutions to Review tasks

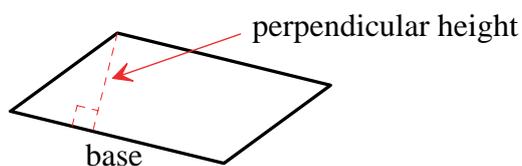
Solutions to Task A

1. (a) Solutions may vary.
For example, perimeter is the distance around the outside of a shape.
- (b) Solutions may vary.
For example, area is the amount of material needed to 'cover' a surface.
- (c) Solutions may vary.
For example, dimension simply refers to length, width and height.
- (d) Solutions may vary.
For example, perpendicular height refers to the distance between the base and the top (apex) of a shape.

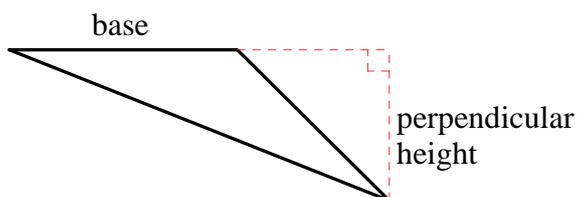


- (b) Solutions may vary.
- For example, to find the area, multiply the number of squares in each row by the number of rows. As the number of squares in each row is represented by the length and the number of rows is represented by the width, multiplying the length by width will give the same result.

3. (a) Solutions may vary.

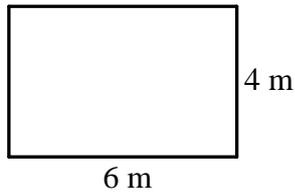


- (b) Solutions may vary.



4.

(a)

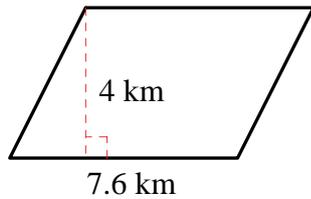


$$A_{\text{(rectangle)}} = 6 \times 4$$

$$= 24$$

\therefore The area is 24 m^2 .

(b)

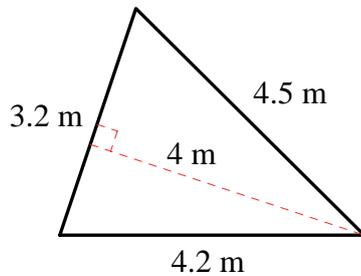


$$A_{\text{(parallelogram)}} = 7.6 \times 4$$

$$= 30.4$$

\therefore The area is 30.4 km^2 .

(c)

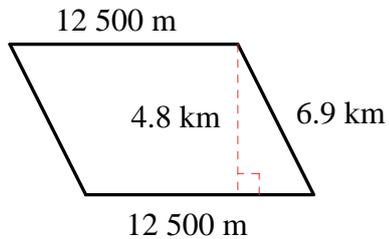


$$A_{\text{(triangle)}} = \frac{1}{2} \times 3.2 \times 4$$

$$= 6.4$$

\therefore The area is 6.4 m^2 .

(d)



In kilometres:

$$12\,500 \div 1000 = 12.5$$

$$A_{\text{(parallelogram)}} = 12.5 \times 4.8$$

$$= 60$$

\therefore The area is 60 km^2 .

In metres:

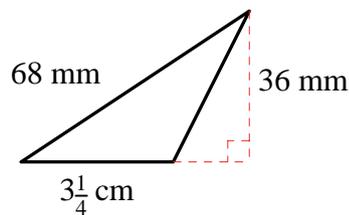
$$4.8 \times 1000 = 4800$$

$$A_{\text{(parallelogram)}} = 12\,500 \times 4800$$

$$= 60\,000\,000$$

\therefore The area is $60\,000\,000 \text{ m}^2$.

(e)



In centimetres:

$$36 \div 10 = 3.6$$

$$A_{\text{(triangle)}} = \frac{1}{2} \times 3.25 \times 3.6$$

$$= 5.85$$

\therefore The area is 5.85 cm^2 .

In millimetres:

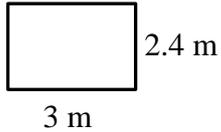
$$3.25 \times 10 = 32.5$$

$$A_{\text{(triangle)}} = \frac{1}{2} \times 32.5 \times 36$$

$$= 585$$

\therefore The area is 585 mm^2 .

5. (a)



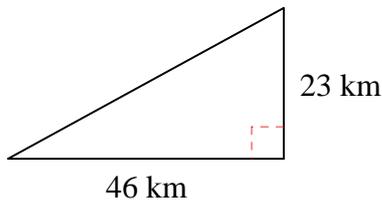
$$\begin{aligned} \text{(b) } A_{\text{(rectangle)}} &= 3 \times 2.4 \\ &= 7.2 \end{aligned}$$

\therefore The area is 7.2 m^2 .

$$\text{(c) } 20 \times 7.2 = 144$$

\therefore At least 144 tiles are required.

6.



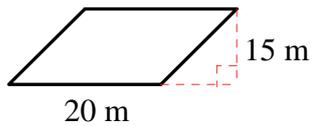
$$\begin{aligned} A_{\text{(triangle)}} &= \frac{1}{2} \times 46 \times 23 \\ &= 529 \end{aligned}$$

\therefore The area is 529 km^2 .

$$529 \times 600 = \$317\,400$$

\therefore The lease will cost \$317 400 to extend for another year.

7. (a)



$$\begin{aligned} A_{\text{(parallelogram)}} &= 20 \times 15 \\ &= 300 \end{aligned}$$

\therefore The area is 300 m^2 .

$$\text{(b) } 300 \times 2 = 600$$

\therefore The combined area is 600 m^2 .

$$\text{(c) } 600 \div 8 = 75$$

\therefore 75 litres of paint are required.

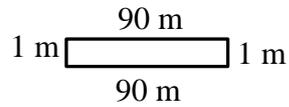
$$\text{(d) } 75 \times 45 = 3375$$

\therefore The cost of the paint is \$3375.

Solutions to Task B

1. No. Reasons may vary.

For example, Kira would not have enough fencing.



$$\begin{aligned} \text{Perimeter} &= 1 + 90 + 1 + 90 \\ &= 182 \end{aligned}$$

\therefore 182 m of fencing is required.

2. (a) $\text{Perimeter} = 1 + 44 + 1 + 44$
 $= 90$

\therefore The perimeter would be 90 m.

- (b) $A_{\text{(rectangle)}} = 1 \times 44$
 $= 44$

\therefore The area is 44 m^2 .

3. (a)

$$\begin{aligned} P &= 10 + w + 10 + w \\ 90 &= 10 + 35 + 10 + 35 \end{aligned}$$

$$\therefore w = 35$$

\therefore The width would be 35 metres.

- (b) $A_{\text{(rectangle)}} = 10 \times 35$
 $= 350$

\therefore The area is 350 m^2 .

- 4.

Pen	dimensions		Perimeter (m)	Area (m^2)
	length	width		
1	10	35	90	350
2	15	30	90	450
3	20	25	90	500
4	22.5	22.5	90	506.25

5. (a) The rectangle with the largest area is 22.5 m by 22.5 m.
(b) It's a square.

6.
$$A_{\text{(triangle)}} = \frac{1}{2} \times 30 \times 26$$
$$= 390$$
$$\therefore \text{The area is } 390 \text{ m}^2.$$

7. Solutions may vary.

Out of the shapes investigated, the pen which is a square has the largest area. (A circular pen would have the greatest area but students are not expected to know this fact. However, some students may be able to extrapolate this idea from their work.)



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