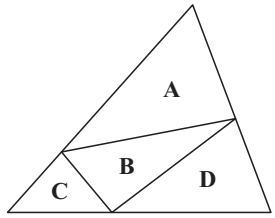
12



A large triangle has been divided into 4 smaller triangles.
Triangle **A** has perimeter 16 cm.
Triangle **B** has perimeter 12 cm.
Triangle **C** has perimeter 5 cm.
Triangle **D** has perimeter 13 cm.
Find the perimeter of the large triangle.

ACTIVITY 2 FINDING PERIMETERS

You will need: Tape measure or metre ruler, trundle wheel.

What to do:

1 Copy the table below.

Item	*Unit of length*	*Estimate*	*Actual perimeter*
front cover of this textbook			
a bank note			
your desk			
largest window in your classroom			
your classroom			
your school gymnasium			

For each item in the table:

a Record the unit of length you will use to measure its perimeter.

b Simply by looking at the item, estimate its perimeter.

c Use an appropriate device to measure the actual perimeter.

PRINTABLE TABLE

2 Compare your measurements with your classmates, and discuss the accuracy of your estimates.

C AREA

All around your school there are flat *surfaces* such as paths, floors, desk tops, ceilings, walls, and courts for playing sport.

Area is a measurement of the size of a surface.

In the metric system, the units we use for area are related to the units we use for length.

1 **square millimetre** (mm^2) is the area enclosed by a square of side length 1 mm.

The area of a computer chip might be measured in mm^2.

1 **square centimetre** (cm^2) is the area enclosed by a square of side length 1 cm.

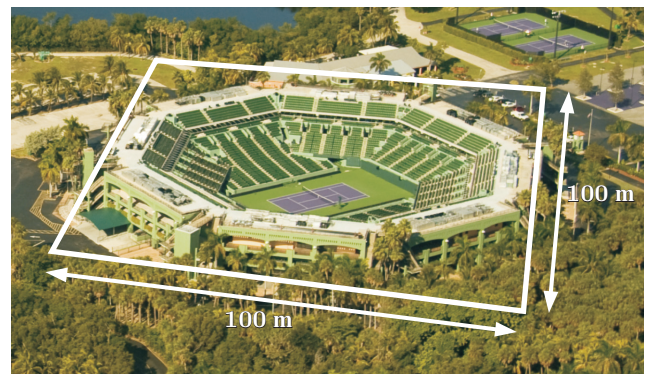
The area of a book cover might be measured in cm^2.

1 **square metre** (m^2) is the area enclosed by a square of side length 1 m.

The area of a brick paved courtyard might be measured in m^2.

1 **hectare** (ha) is the area enclosed by a square of side length 100 m.

The area of a park or a sports stadium might be measured in hectares.



Tennis stadium at Crandon Park, Miami, Florida, USA

1 **square kilometre** (km^2) is the area enclosed by a square of side length 1 km.

The area of a country or continent might be measured in km^2.

EXERCISE 12C

1 State the units that would be most appropriate for measuring the area of:

a the floor of a room **b** a sheet of paper **c** Tanzania

d a dot on a die **e** a farm.

2 Choose the correct answer:

a The area of a movie theatre screen is about:

A 18 m^2 **B** 180 m^2 **C** 18 ha **D** 180 ha

b The area of a doormat is about:

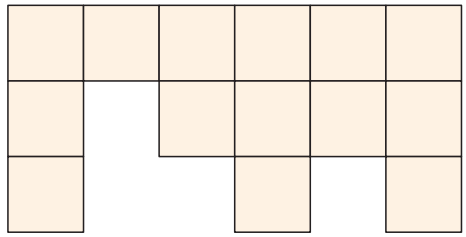
A 20 cm^2 **B** 200 cm^2 **C** 2000 cm^2 **D** 2 m^2

c The area of a 20 cent coin is about:

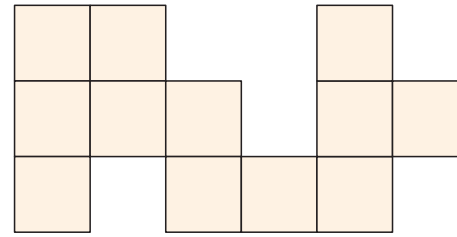
A 65 mm^2 **B** 6.5 cm^2 **C** 65 cm^2 **D** 6.5 m^2

3 Each of the squares in these shapes has area 1 square centimetre. Count the squares to find the area of each shape.

a



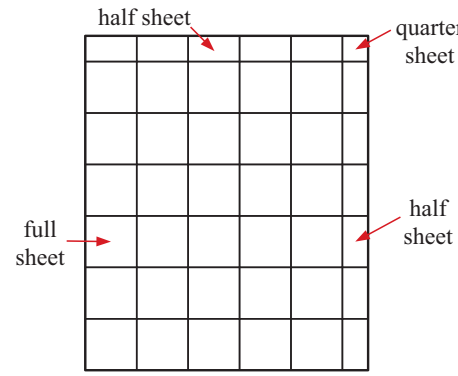
b



4 To find the area of their classroom, students covered the floor with 1 m by 1 m squares of paper.

Once they had used as many full sheets as possible, they used half sheets and finally one quarter sheet to finish covering the floor.

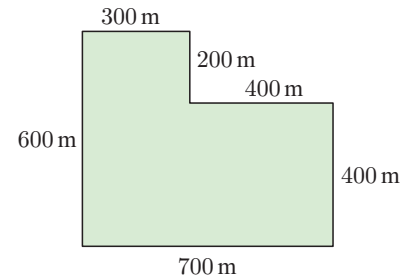
Find the area of the classroom.



5 Lucinda's farm has the dimensions shown.

a By dividing the farm into 100 m by 100 m squares, find the area of the farm in hectares.

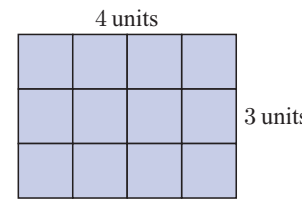
b Lucinda uses half of her farm to grow bamboo. It has an annual yield of 20 tonnes per hectare. How much bamboo does Lucinda's farm produce each year?



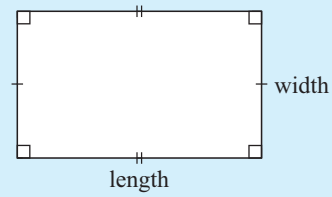
D THE AREA OF A RECTANGLE

Consider a rectangle 4 units long and 3 units wide.

The area of this rectangle is 12 units^2, and we can find this by multiplying $4 \times 3 = 12$.



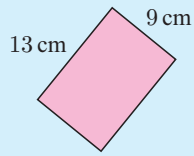
Area of rectangle = length × width



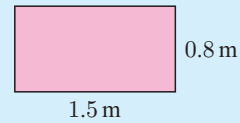
Example 3 Self Tutor

Find the area of each rectangle:

a



b



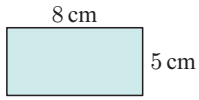
a Area
$= \text{length} \times \text{width}$
$= 13 \text{ cm} \times 9 \text{ cm}$
$= 117 \text{ cm}^2$

b Area
$= \text{length} \times \text{width}$
$= 1.5 \text{ m} \times 0.8 \text{ m}$
$= 1.2 \text{ m}^2$

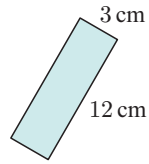
EXERCISE 12D

1 Find the area of each rectangle. Make sure you answer with the correct units.

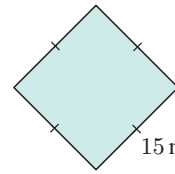
a



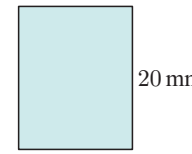
b



c



d



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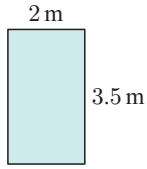

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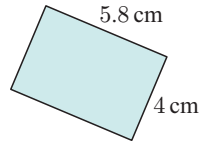

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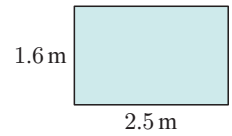
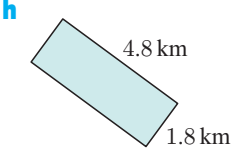
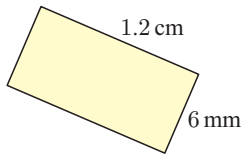


h

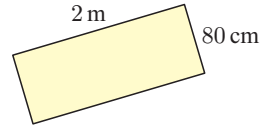


2 Find the area of each rectangle:

a



b



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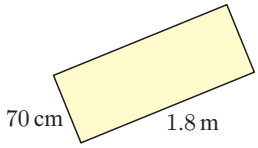

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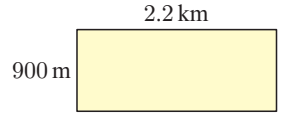
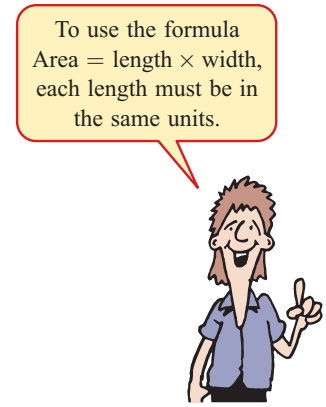




3 An office building has 10 large windows which are 2 m wide and 3 m high, and 5 small windows which are 1 m wide and 1.5 m high.
Find the total area of glass in the windows of the building.

4 A lawn bowls club has a green with dimensions 40 m by 60 m. 30 square metres can be mowed each minute.

a Find the area of the green. **b** How long will it take to mow the whole green?

5 A hallway is 9 m long and 1.8 m wide. It is to be covered in floorboards which are 1.5 m long and 15 cm wide. Each floorboard costs $21.50.

Find the:

a area of each floorboard in m^2 **b** area of the floor

c number of floorboards required **d** total cost of the floorboards.

Example 4 **Self Tutor**

A rectangle is 13 m long. Its area is 65 m^2. Find the width of the rectangle.

Let the width of the rectangle be x m.

Area = length $\times$ width

$\therefore \ 65 = 13 \times x$

$\therefore \ \frac{65}{13} = \frac{13x}{13}$ {dividing both sides by 13}

$\therefore \ x = 5$

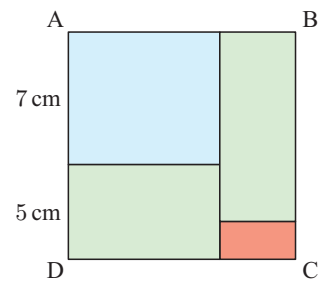
The width of the rectangle is 5 m.

6 A rectangle is 8 cm long. Its area is 48 cm^2. Find the width of the rectangle.

7 A rectangle has area 84 m^2. It is 7 m wide. Find the length of the rectangle.

8 According to the local council rules, advertising signs on a street must be no larger than 12 m^2. Neville wants his sign to be 2.5 m high. What is the maximum length his sign can be?

9 In the square ABCD, the green rectangles have the same area and the blue rectangle has area 56 cm^2. Find the area of the red rectangle.



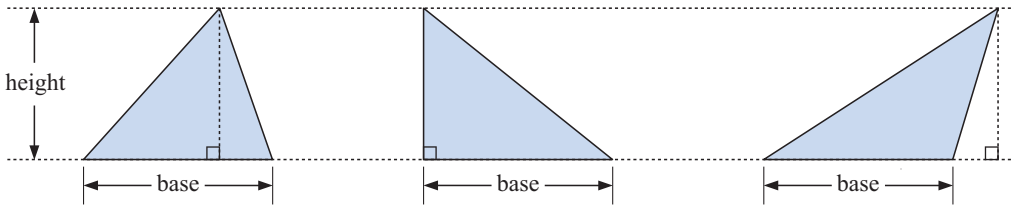
GLOBAL CONTEXT — SHIKAKU PUZZLES

Global context: Scientific and technical innovation

Statement of inquiry: Solving mathematical puzzles can help us to better understand mathematical concepts.

Criterion: Investigating patterns

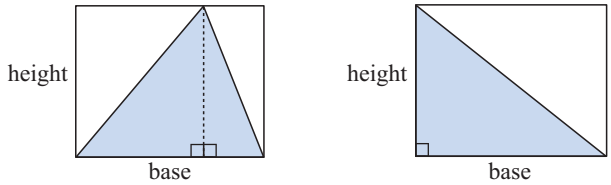
E THE AREA OF A TRIANGLE



Area of triangle $= \frac{1}{2} \times$ **base** $\times$ **height**

DEMO

The first two cases are demonstrated by drawing a rectangle with the same base and height as the triangle.

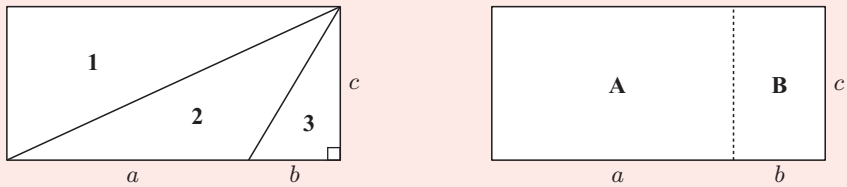


$$\text{Area} = \frac{1}{2} \text{ of area of rectangle}$$
$$= \frac{1}{2} \times \text{base} \times \text{height}$$

We prove the third case in the **Activity** below.

ACTIVITY 3 AREA OF A TRIANGLE

Below are two rectangles which each have length $(a + b)$ and height c.



The first rectangle has been divided into three triangles.

The second rectangle has been divided into two smaller rectangles **A** and **B**.

What to do:

1 In terms of a, b, and c, write down formulae for:

a area **A** **b** area **B** **c** area **3**

2 Copy and complete:

Using the first rectangle, area **1** = area **2** + area **3**

Comparing rectangles, area **1** + area **2** + area **3** = area **A** + area **B**

$\therefore$ 2 $\times$ area **2** + 2 $\times$ area **3** = area **A** + area **B**

$\therefore$ 2 $\times$ area **2** = area **A** + area **B** − 2 $\times$ area **3**

Using the formulae in **1**, $2 \times \text{area } \mathbf{2} = \ldots\ldots + \ldots\ldots - 2 \times \ldots\ldots$

$= \ldots\ldots$

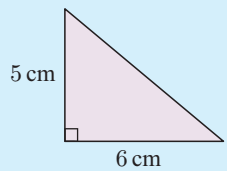
$\therefore \text{ area } \mathbf{2} = \frac{1}{2} \times \ldots\ldots$

$= \frac{1}{2} \times \text{base} \times \text{height}$

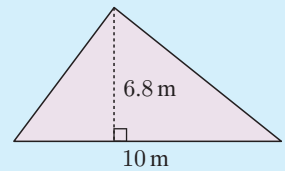
Example 5 **Self Tutor**

Find the area of each triangle:

a



b



a $\text{Area} = \frac{1}{2} \times \text{base} \times \text{height}$

$= \frac{1}{2} \times 6 \text{ cm} \times 5 \text{ cm}$

$= 15 \text{ cm}^2$

b $\text{Area} = \frac{1}{2} \times \text{base} \times \text{height}$

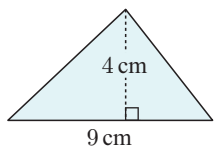
$= \frac{1}{2} \times 10 \text{ m} \times 6.8 \text{ m}$

$= 34 \text{ m}^2$

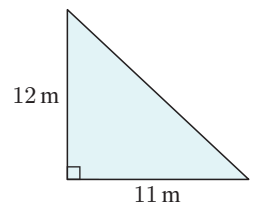
EXERCISE 12E

1 Find the area of each triangle:

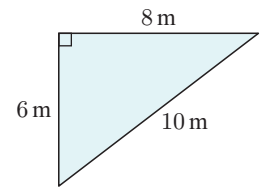
a



b



c



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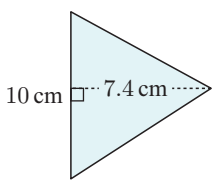
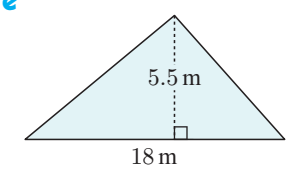


e



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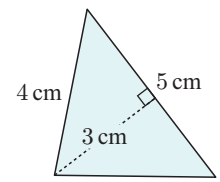
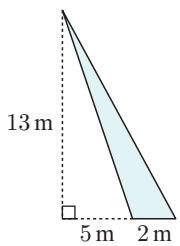


g



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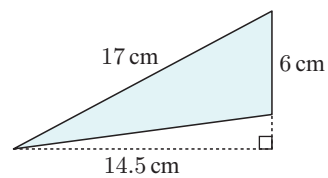
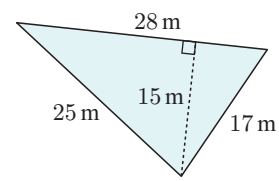
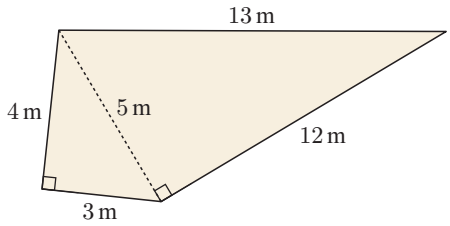


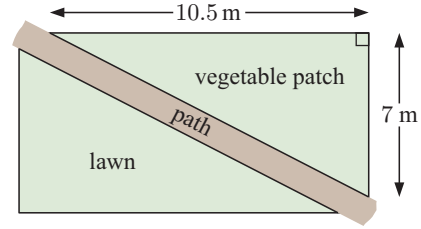
i



2 Find the area of this quadrilateral.

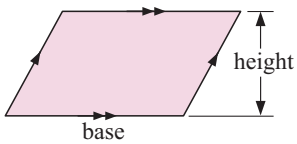


3 A path cuts across a backyard as shown. Find the area of the vegetable patch.



4 A triangle with base length 5 cm has area 15 cm^2. Find the height of the triangle.

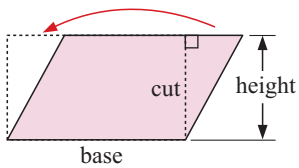
F THE AREA OF A PARALLELOGRAM

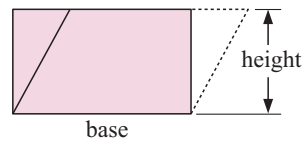


Area of parallelogram = base × height

We can demonstrate this formula by cutting out a triangle from one end of the parallelogram and shifting it to the other end. The resulting shape is a rectangle with the same base and height as the parallelogram.

DEMO

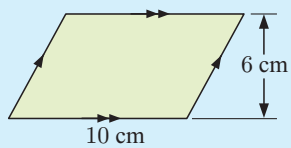




Perform this demonstration for yourself using paper and scissors.

Example 6 — Self Tutor

Find the area of this parallelogram:

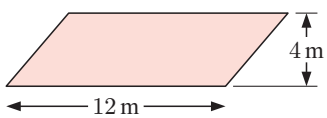


Area = base × height
= 10 cm × 6 cm
= 60 cm^2

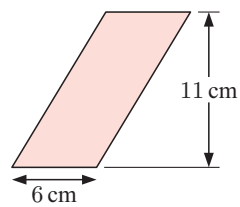
EXERCISE 12F

1 Find the area of each parallelogram:

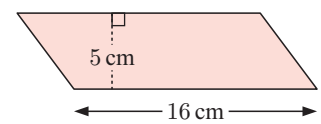
a



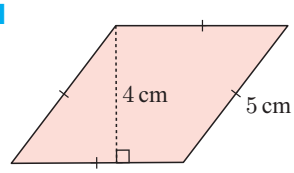
b



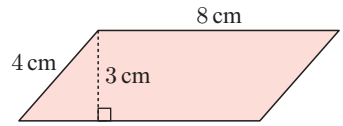
c



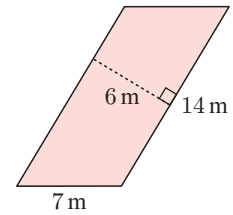
d



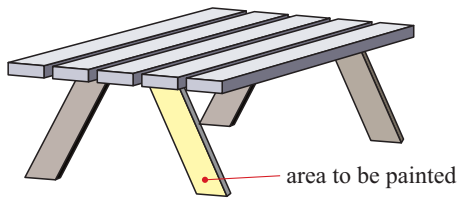
e



f

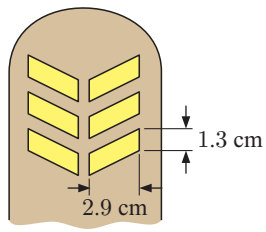


2

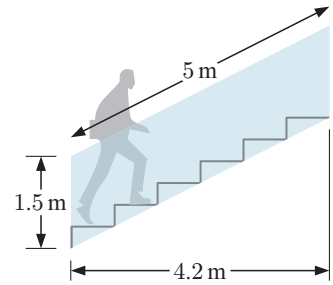


The surface of the park bench leg indicated must be repainted due to graffiti. The leg is 12 cm wide at the base, and the top of the leg is 60 cm above the ground. Find the area that needs to be repainted.

3 A soldier's uniform has these stripes on *both* shoulders.
Find the total area of the stripes on the uniform.



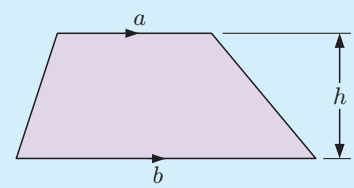
4 A perspex safety guard for one side of a staircase is to be made with the dimensions shown. Find the area of perspex required.



G THE AREA OF A TRAPEZIUM

Area of trapezium = average length of parallel sides
× distance between parallel sides

$$= \left(\frac{a+b}{2}\right) \times h$$



We can demonstrate this result using a second identical trapezium.

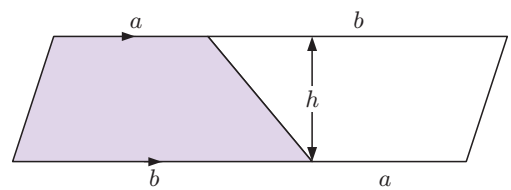
We place the trapezia together to form a parallelogram.

DEMO

$$\text{Area} = \frac{1}{2} \text{ of area of parallelogram}$$

$$= \frac{1}{2} \times \text{base} \times \text{height}$$

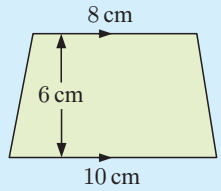
$$= \frac{1}{2} \times (a+b) \times h$$



Perform this demonstration for yourself using paper and scissors.

Example 7 — Self Tutor

Find the area of this trapezium:

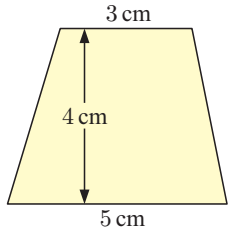


$$\text{Area} = \left(\frac{a+b}{2}\right) \times h$$
$$= \left(\frac{8+10}{2}\right) \times 6 \text{ cm}^2$$
$$= 9 \times 6 \text{ cm}^2$$
$$= 54 \text{ cm}^2$$

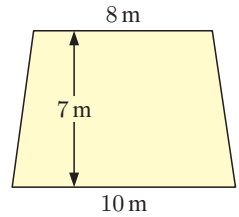
EXERCISE 12G

1 Find the area of each trapezium:

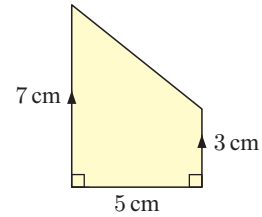
a



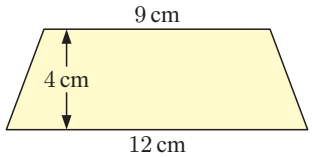
b



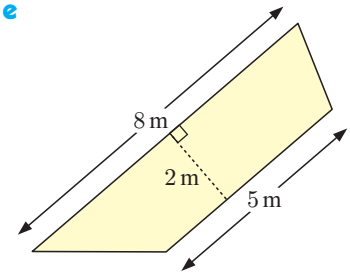
c



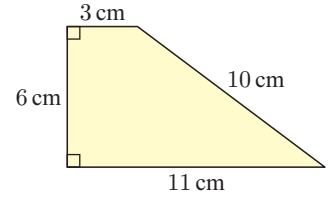
d



e



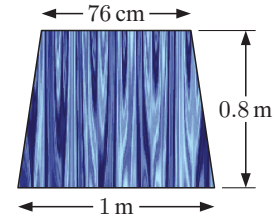
f



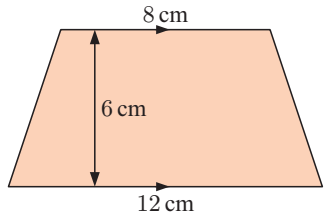
2 Joan is using a trapezium-shaped piece of material to make a skirt.

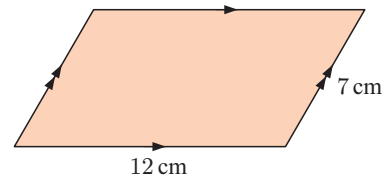
a Find the area of the material in m^2.

b The material is worth \$16 per square metre. Find the total value of the material.



3 These figures have the same area. Find the height of the parallelogram.





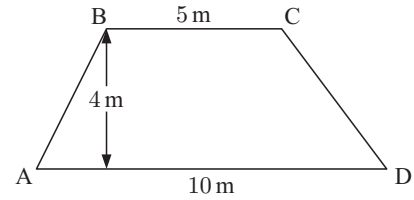
4 **a** Find the area of trapezium ABCD.

b Draw in the line segment [BD].
We divide the trapezium into triangles ABD and BCD.

i Find the area of triangle ABD.

ii Find the area of triangle BCD.

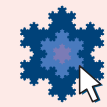
iii Verify that the sum of the areas of the triangles is equal to the area of the trapezium.



ACTIVITY 4 AREAS OF IRREGULAR SHAPES

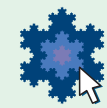
In this Activity we estimate the areas of irregular shapes which are bounded by curves.

ACTIVITY



MULTIPLE CHOICE QUIZ

QUICK QUIZ



REVIEW SET 12A

1 Convert:

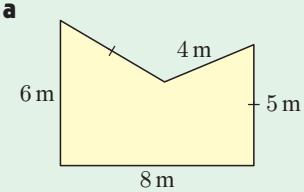
a 12.9 cm into mm **b** 3.95 km into m **c** 2.43 m into cm

d 57 mm into cm **e** 1140 cm into m **f** 640 m into km.

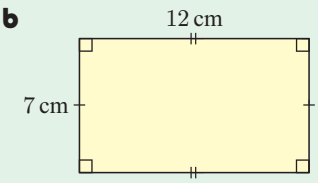
2 Find, in metres, the sum of 2 km, 510 m, and 190 cm.

3 Find the perimeter of each figure:

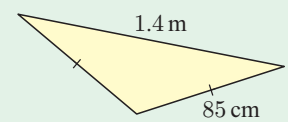
a



b



c



4 A 360 m length of wire is cut into equal lengths, which are then bent into equilateral triangles with side length 15 cm. How many triangles can be made?

5 State the units that would be most appropriate for measuring the area of:

a a gymnasium floor **b** India **c** a postcard.