WALT calculate the area of different shapes, including squares, rectangles, triangles, circles, and composite shapes.

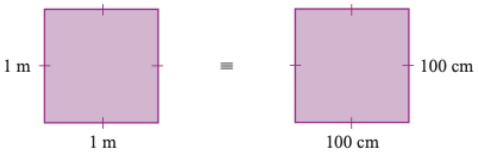
Success Criteria :I can…

- define the area of a shape.
- identify the different formulas for calculating the area of different shapes.
- use the formulas to calculate the area of different shapes, both accurately and efficiently.
- check my calculations for accuracy.
- apply my knowledge of area to solve real-world problems.

Area conversions

$A = 1 \times 1\ \text{cm}^2$ or $A = 10 \times 10\ \text{mm}^2$

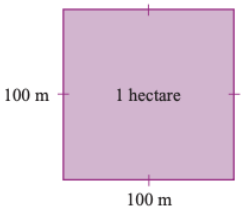
$1\ \text{cm}^2 = 100\ \text{mm}^2$



$A = 1 \times 1\ \text{m}^2$ or $A = 100 \times 100\ \text{cm}^2$

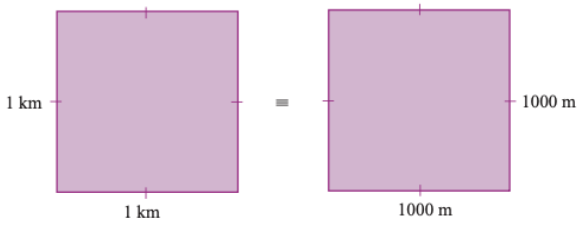
$1\ \text{m}^2 = 10\ 000\ \text{cm}^2$

A hectare is the area of a square of side length 100 m.



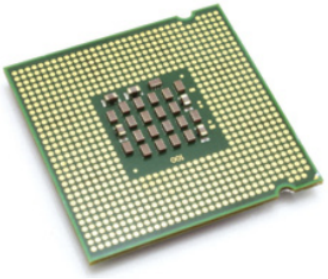
$A = 100 \times 100\ \text{m}^2$

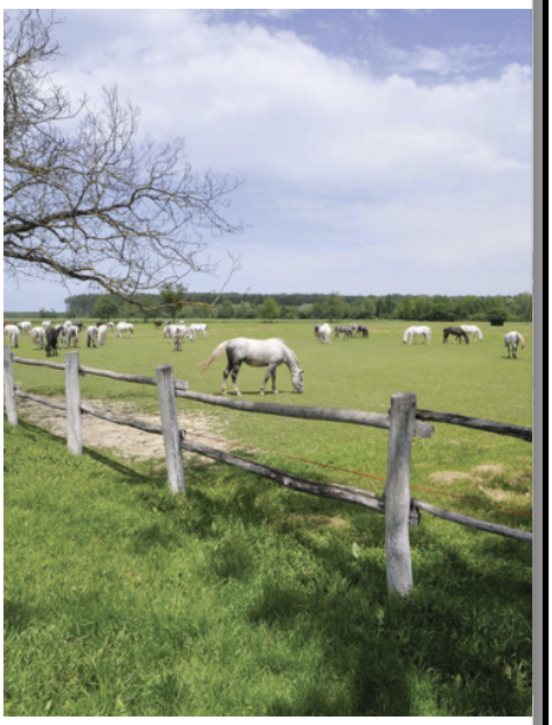
$1\ \text{ha} = 10\ 000\ \text{m}^2$



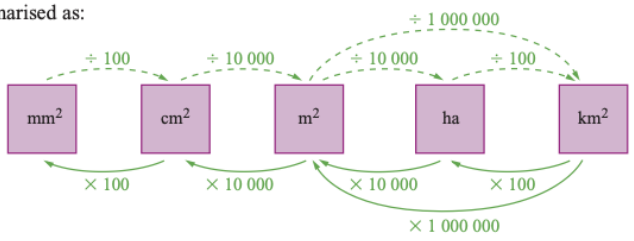
$A = 1 \times 1\ \text{km}^2$ or $A = 1000 \times 1000\ \text{m}^2$

$1\ \text{km}^2 = 1\ 000\ 000\ \text{m}^2$





This may be summarised as:



EXAMPLE 1

Convert the following measurements.

a 25 cm^2 to mm^2 **b** 2000 cm^2 to m^2 **c** 4.3 ha to m^2 **d** 5 600 000 m^2 to km^2

	Solve	Think	Apply
a	$25\ cm^2 = 25 \times 100$ $= 2500\ mm^2$	Multiply by 100.	Use the conversion diagram to multiply or divide, as appropriate.
b	$2000\ cm^2 = \frac{2000}{10\,000}$ $= 0.2\ m^2$	Divide by 10 000.	
c	$4.3\ ha = 4.3 \times 10\,000$ $= 43\,000\ m^2$	Multiply by 10 000.	
d	$5\,600\,000\ m^2 = \frac{5\,600\,000}{1\,000\,000}$ $= 5.6\ km^2$	Divide by 1 000 000.	

Exercise 6A

1 Convert the following areas.

a 4 cm^2 to mm^2 **b** 31 m^2 to cm^2 **c** 32 km^2 to m^2 **d** 40 000 cm^2 to m^2

e 7.3 ha to m^2 **f** 42 000 m^2 to ha **g** 15 cm^2 to mm^2 **h** 32 000 cm^2 to m^2

i 3280 mm^2 to cm^2 **j** 235 000 m^2 to km^2 **k** 36.5 ha to m^2 **l** 780 m^2 to ha

EXAMPLE 2

Convert the following measurements.

a $3.8\ m^2$ to mm^2
b $0.5\ km^2$ to cm^2
c $25\ 000\ 000\ cm^2$ to ha
d $4\ km^2$ to ha

	Solve/Think	Apply
a	$3.8\ m^2 = 3.8 \times 10\ 000\ cm^2 = 3.8 \times 10\ 000 \times 100$ $= 3\ 800\ 000\ mm^2$	Use the conversion factors twice, as appropriate, to change to the required unit.
b	$0.5\ km^2 = 0.5 \times 1\ 000\ 000\ m^2 = 0.5 \times 1\ 000\ 000 \times 10\ 000$ $= 5\ 000\ 000\ 000\ cm^2$	
c	$25\ 000\ 000\ cm^2 = \frac{25\ 000\ 000}{10\ 000}\ m^2$ $= \frac{25\ 000\ 000}{10\ 000 \times 10\ 000}$ $= 0.25\ ha$	
d	$4\ km^2 = 4 \times 1\ 000\ 000\ m^2$ $= \frac{4 \times 1\ 000\ 000}{10\ 000}$ $= 400\ ha$	

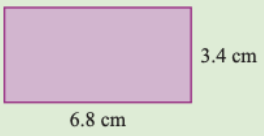
2 Convert the following.

a $7\ 000\ 000\ mm^2$ to m^2 **b** $5.3\ m^2$ to mm^2 **c** $3\ 600\ 000\ cm^2$ to ha **d** $1\ km^2$ to ha
e $2.3\ km^2$ to ha **f** 0.0042 ha to cm^2 **g** $0.002\ m^2$ to mm^2 **h** 6.3 ha to km^2

Areas of rectangles, triangles, parallelograms and circles

EXAMPLE 3

Find the area of this rectangle.

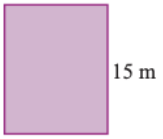


Solve/Think	Apply
$A = lb$ $= 6.8 \times 3.4 = 23.12\ cm^2$	Area of a rectangle $= l \times b$

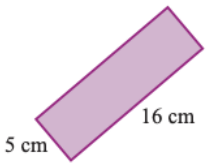
3 Find the area of each rectangle.

a

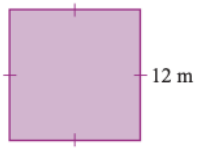
b



c

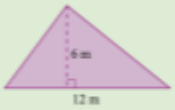


d



EXAMPLE 4

Find the area of each triangle.

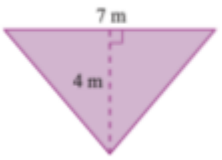
a 

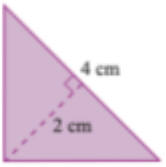
b 

c 

	Solve/Think	Apply
a	$A = \frac{1}{2}bh$ $= \frac{1}{2} \times 12 \times 6\ \text{m}^2$ $= 36\ \text{m}^2$	Area of a triangle $= \frac{1}{2} \times b \times h$ The base and height must be perpendicular to each other. In an obtuse-angled triangle, the base or height may be 'outside' the triangle.
b	$A = \frac{1}{2}bh$ $= \frac{1}{2} \times 4.2 \times 3\ \text{m}^2$ $= 6.3\ \text{m}^2$	
c	$A = \frac{1}{2}bh$ $= \frac{1}{2} \times 6.8 \times 6\ \text{cm}^2$ $= 20.4\ \text{cm}^2$	

4 Find the area of each triangle.

a 

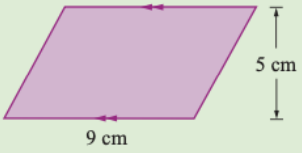
b 

c 

d 

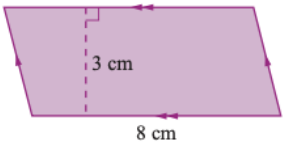
EXAMPLE 5

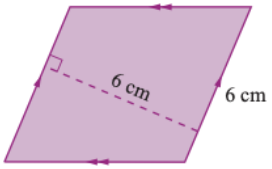
Find the area of this parallelogram.

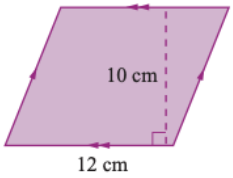


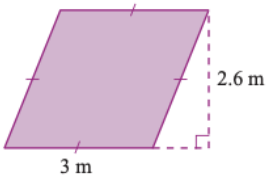
Solve/Think	Apply
$A = bh$ $= 9 \times 5 = 45\ \text{cm}^2$	Area of a parallelogram $= b \times h$ where b is the length of the base and h is the perpendicular height.

5 Find the area of each parallelogram.

a 

b 

c 

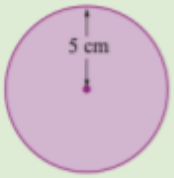
d 

Area of circles

EXAMPLE 6

Find the area of each circle correct to 1 decimal place.

a



b

	Solve/Think	Apply
a	$A = \pi r^2 = \pi \times 5^2$ $= 25\pi \approx 78.5 \text{ cm}^2$	Area of a circle $= \pi r^2$
b	$A = \pi r^2 = \pi \times 6^2$ $= 36\pi \approx 113.1 \text{ m}^2$	

6 Find the area of each circle correct to 2 decimal places.

a

b

c

d

e

f

Investigation 1 Formulas for area

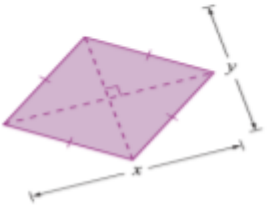
You know that the area of a triangle is: $A = \frac{1}{2}bh$

Use this formula to find expressions for the area of a rhombus, kite and trapezium.

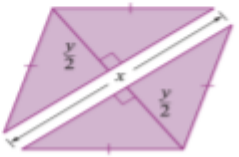
1 Rhombus

Use these diagrams to find expressions for the area of a rhombus with diagonals x and y units in length.

a

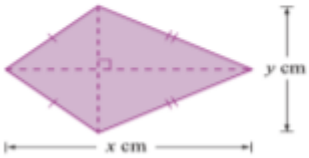


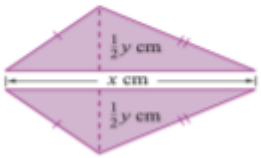
b



2 Kite

The formula for the area of a kite is the same as that for a rhombus. Compare this derivation with your expressions from question **1**.

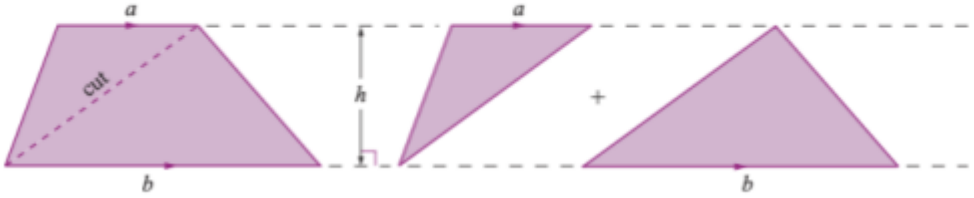




$$A = \tfrac{1}{2} \times x \times (\tfrac{1}{2}y) + \tfrac{1}{2} \times x \times (\tfrac{1}{2}y)$$
$$= \tfrac{1}{4}xy + \tfrac{1}{4}xy$$
$$= \tfrac{1}{2}xy$$

3 Trapezium

Use these diagrams to find an expression for the area of a trapezium.



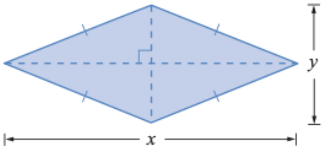
B Areas of special quadrilaterals

From Investigation 1, we have developed the following formulas.

Rhombus

$A = \frac{1}{2}xy$

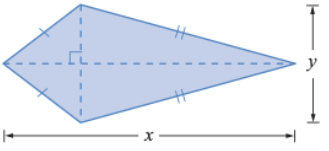
$A = \frac{1}{2} \times$ product of the lengths of the diagonals



Kite

$A = \frac{1}{2}xy$

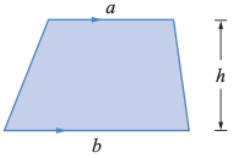
$A = \frac{1}{2} \times$ product of the lengths of the diagonals



Trapezium

$A = \frac{1}{2}ah + \frac{1}{2}bh$

$= \frac{1}{2}h(a + b)$ or $A = \left(\frac{a + b}{2}\right)h$

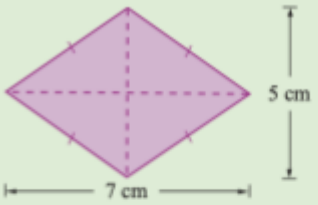


$A =$ product of half the height and the sum of the lengths of the parallel sides
or product of the height and the average of the lengths of the parallel sides

Note: The height is the perpendicular distance between the two parallel sides. Sometimes it is a side but usually it is not.

EXAMPLE 1

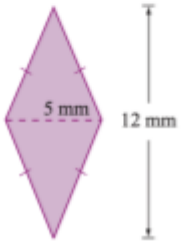
Find the area of a rhombus with diagonals of length 5 cm and 7 cm.



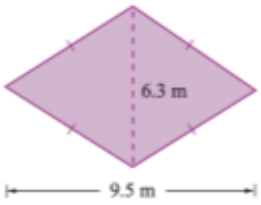
Solve/Think	Apply
$A = \frac{1}{2}xy$ $= \frac{1}{2} \times 5 \times 7 = 17.5 \text{ cm}^2$	Area of a rhombus $= \frac{1}{2}xy$ where x and y are the lengths of the diagonals.

1 Find the area of each rhombus.

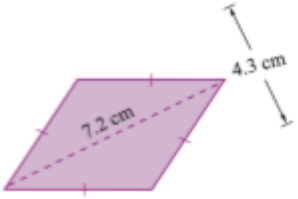
a



b

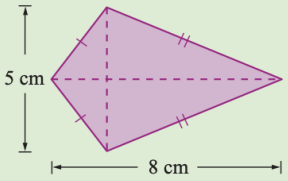


c



EXAMPLE 2

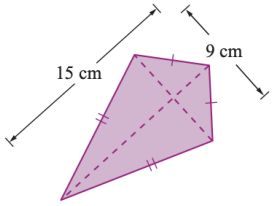
Find the area of this kite.



Solve/Think	Apply
$A = \frac{1}{2}xy$ $= \frac{1}{2} \times 5 \times 8$ $= 20 \text{ cm}^2$	Area of a kite $= \frac{1}{2}xy$ where x and y are the lengths of the diagonals.

2 Find the area of each kite.

a



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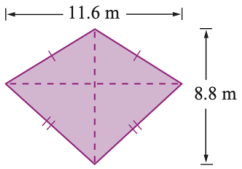
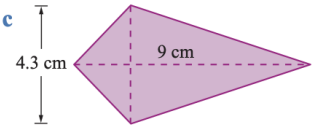
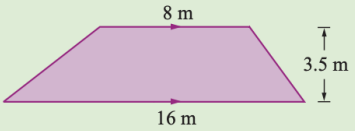


c



EXAMPLE 3

Find the area of this trapezium.

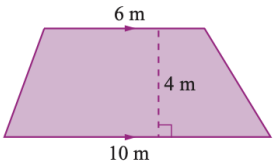


Solve/Think	Apply
$A = \frac{1}{2}h(a + b)$ $= \frac{1}{2} \times 3.5(8 + 16) = 42 \text{ m}^2$	First identify the height, then use the formula. Area of a trapezium $= \frac{1}{2}h(a + b)$ or $\frac{h(a + b)}{2}$

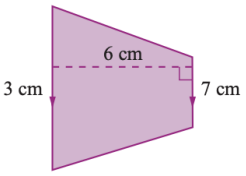
3 Find the area of each trapezium. Identify the height first.

The height is perpendicular to the parallel sides.

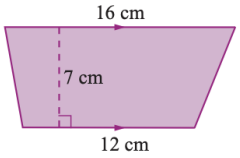
a



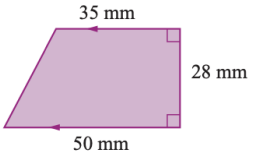
b



c

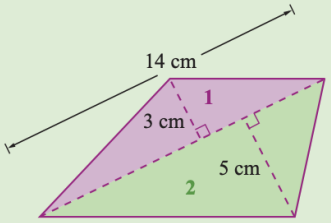


d



EXAMPLE 4

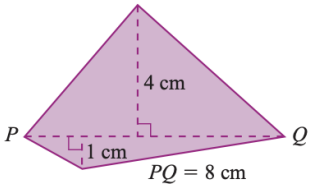
Find the area of this quadrilateral.



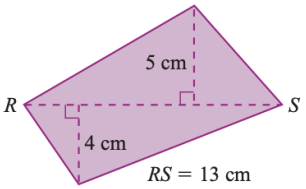
Solve/Think	Apply
A = area of triangle 1 + area of triangle 2 $= \frac{1}{2} \times 14 \times 3 + \frac{1}{2} \times 14 \times 5$ $= 21 + 35 = 56 \text{ cm}^2$	Divide the quadrilateral into 2 triangles.

4 Find the area of each quadrilateral.

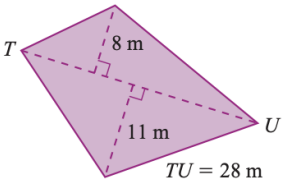
a

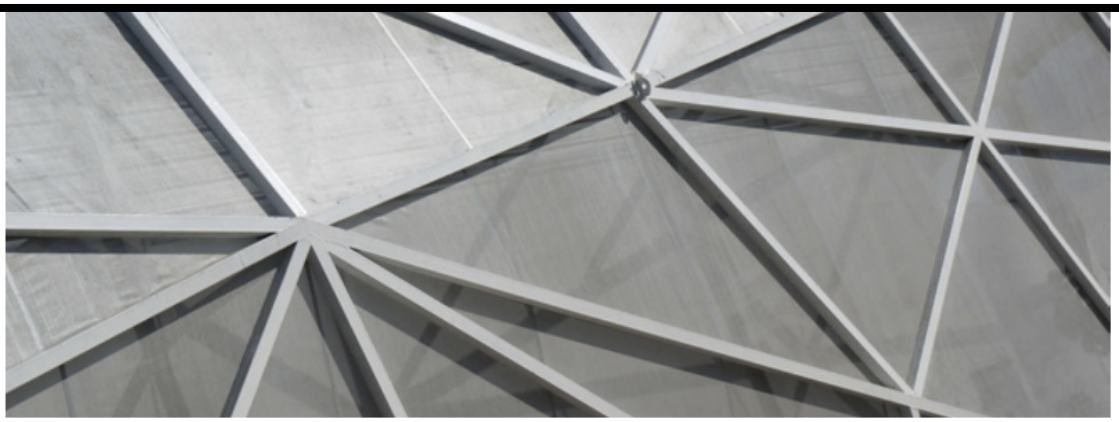


b



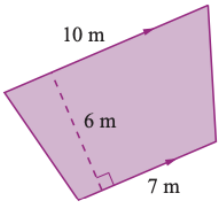
c



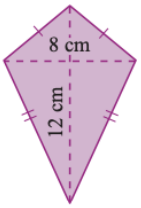


5 Use the correct formula to find the area of each quadrilateral.

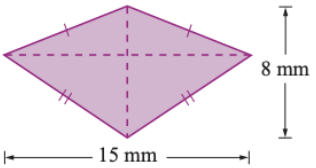
a



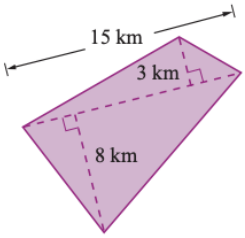
b



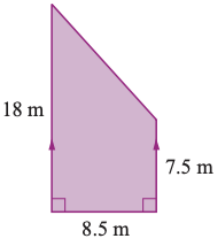
c



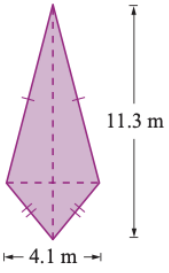
d



e



f



Exercise 6A

1 **a** 400 mm^2 **b** 310 000 cm^2
c 32 000 000 m^2 **d** 4 m^2
e 73 000 m^2 **f** 4.2 ha
g 1500 mm^2 **h** 3.2 m^2
i 32.8 cm^2 **j** 0.235 km^2
k 365 000 m^2 **l** 0.078 ha

2 **a** 7 m^2 **b** 5 300 000 mm^2
c 0.036 ha **d** 100 ha
e 230 ha **f** 420 000 cm^2
g 2000 mm^2 **h** 0.063 km^2

3 **a** 32 cm^2 **b** 180 m^2
c 80 cm^2 **d** 144 m^2

4 **a** 14 m^2 **b** 4 cm^2
c 880 m^2 **d** 36 cm^2

5 **a** 24 cm^2 **b** 36 cm^2
c 120 cm^2 **d** 7.8 m^2

6 **a** 201.06 cm^2 **b** 153.94 m^2
c 56.75 cm^2 **d** 30.19 cm^2
e 183.85 m^2 **f** 1.25 km^2

Exercise 6B

1 **a** 30 mm^2 **b** 29.925 m^2 **c** 15.48 cm^2

2 **a** 67.5 cm^2 **b** 51.04 m^2 **c** 19.35 cm^2

3 **a** $h = 4$ m, $A = 32$ m^2
b $h = 6$ cm, $A = 30$ cm^2
c $h = 7$ cm, $A = 98$ cm^2
d $h = 28$ mm, $A = 1190$ mm^2

4 **a** 20 cm^2 **b** 58.5 cm^2 **c** 266 m^2

5 **a** 51 m^2 **b** 48 cm^2 **c** 60 mm^2
d 82.5 km^2 **e** 108.375 m^2 **f** 23.165 m^2