17 Area

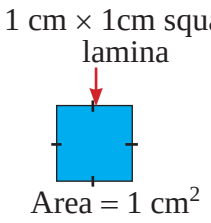
By studying this lesson you will be able to

- identify the units used to measure areas,
- find the areas of squares and rectangles using formulae,
- find areas of composite plane figures, and
- solve problems related to area

17.1 Area

You have learnt in grade 6 that the extent of a surface is called the area of that surface.

The area of a square lamina of side length 1 cm is used as the standard unit to measure areas. This is defined as one square centimetre and is denoted by 1 cm^2.



Two birthday cards are shown in the figure. The extent of the surface of each card is called the area of each picture.

(a)

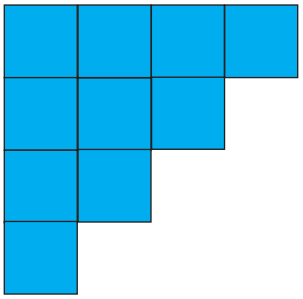
(b)

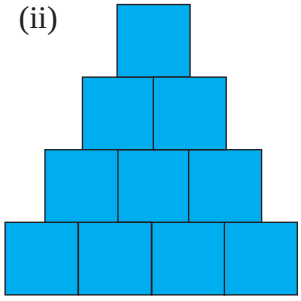
You can identify that the area of (b) is greater than the area of (a).

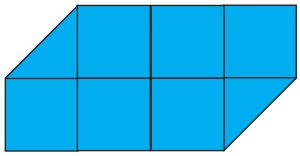
Do the following review exercise to recall the above facts which were learnt in Grade 6.

Review Exercise

(1) Considering the area of a small square to be 1 cm^2, find the area of each of the figures given below.

(i) 

(ii) 

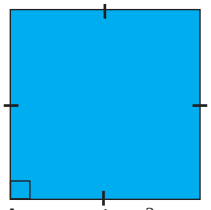
(iii) 

17.2 More on units used to measure areas

The unit 1 cm^2 is not sufficient to measure the areas of surfaces such as walls, parapet walls, the floor of a classroom and flower beds. Even the length measurements of such surfaces are obtained using metres and not centimetres.

Consider a square shaped portion of a floor of side length 1 m. It is too large to be drawn in a book. A reduced shape of such a surface is shown in the figure.

1 m ×1 m
square lamina



Area = 1 m^2

The area of a square lamina of side length 1 m is one square metre. This is denoted by 1 m^2.

The area of the square shaped portion of the floor shown in the figure is 1 m^2. Do the following activity to gain an understanding of the extent of a 1 m^2 surface area.

Activity 1

Step 1 - Get a few newspapers, a pair of scissors, a meter ruler or a measuring tape and some glue.

Step 2 - Paste the newspapers together appropriately and cut out a square lamina of side length 1 m.

Step 3 - Cut out another square lamina of side length 1 cm.

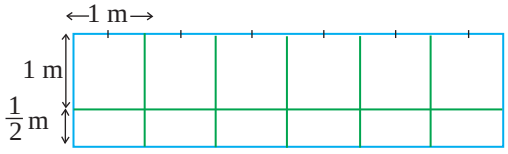
Step 4 - What is the area of each square lamina you cut out?

Step 5 - Can you easily identify how many times the area of the small square the area of the large square is?

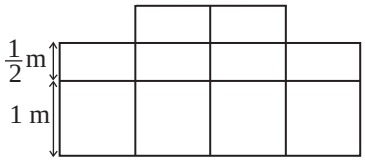
By doing the above activity you would have realized that a surface area of 1 m^2 is very large compared to a surface area of 1 cm^2.

Exercise 17.1

(1) The figure shows how the wall of a school has been divided into square shaped and rectangular shaped sections for paintings to be done on them. What is the total surface area allocated for paintings in square metres?



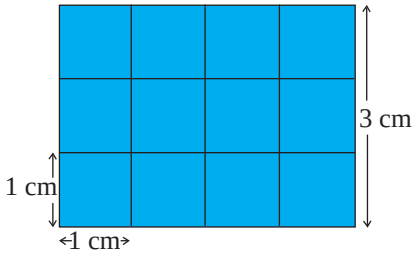
(2) What is the area of the figure shown here which is made out of equal sized squares and equal sized rectangles?



17.3 Formulae for the area of a square and the area of a rectangle

The rectangular lamina shown in the figure which is of length 4 cm and breadth 3 cm is divided into square laminas of side length 1 cm.

Since there are 12 small squares, the area of this rectangle is 12 cm^2. The length of this rectangle is 4 cm.



Number of squares in a row = 4

Number of rows = 3

∴ Total number of squares = 4 × 3

= 12

∴ The area of the figure = 12 cm^2

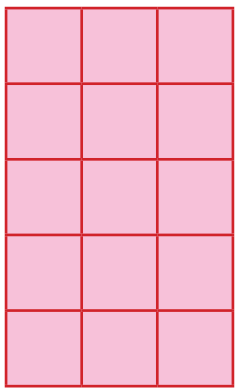
As the length of the rectangle is 4 cm and the breadth is 3 cm,

the area of the figure = (length × breadth) cm^2

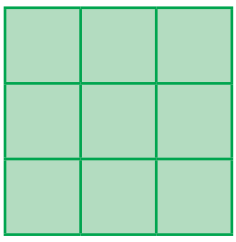
Based on the above explanation it is clear that the area of a rectangle can be found using its length and its breadth, without counting the squares of area 1cm^2. Do the following activity to establish this further.

Activity 2

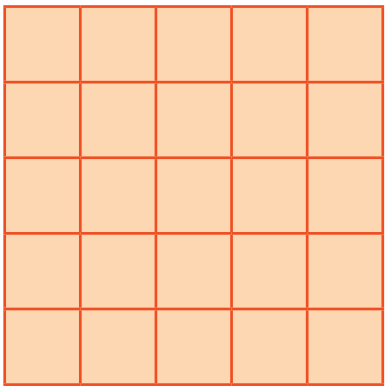
Consider the length of each side of a small square into which each of the shapes given below are divided, to be 1 cm. Copy and complete the table based on these shapes.



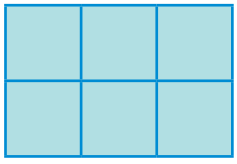
(a)



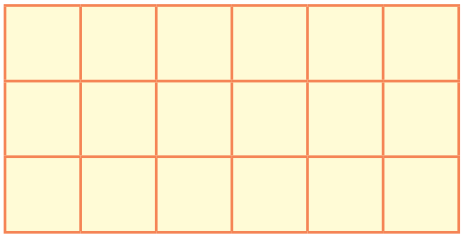
(b)



(c)



(d)



(e)

Figure	Number of squares in a row	Number of rows	Specific name of the figure	Total number of squares	Area	Area of the rectangle = length × breadth
a	3	5	Rectangle	$3 \times 5 = 15$	15 cm^2	3 cm × 5 cm = 15 cm^2
b	.....	.....	.....	.....	.....	.....
c	.....	.....	.....	.....	.....	.....
d	.....	.....	.....	.....	.....	.....
e	.....	.....	.....	.....	.....	.....

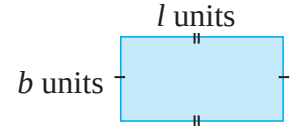
• Formula for the area of a rectangle

It is clear from this activity that the area of the rectangle obtained by counting the small squares can also be found using the length and the breadth of the rectangle.

Now let us obtain a formula for the area of a rectangle of length l units and breadth b units

The area of the rectangle = length × breadth

$\therefore$ The area of the rectangle = $l \times b$ square units



If the area of a rectangle of length l units and breadth b units is A square units, then $A = lb$.

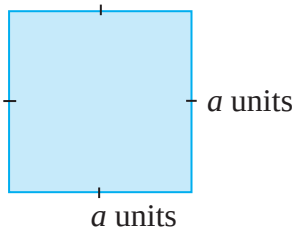
• Formula for the area of a square

Let us similarly, obtain a formula for the area of a square.

The area of the square = length × breadth

$= a \times a = a^2$

$\therefore$ The area of the square = a^2 square units



If the area of a square of side length a units is A square units, then $A = a^2$

Example 1

Find the area of the rectangular wall hanging of length 12 cm and breadth 5 cm.

The area of a rectangle of length l and breadth b $= lb$

$\therefore$ The area of the wall hanging $= 12 \times 5 \text{ cm}^2$

$= 60 \text{ cm}^2$

Example 2

The length of a side of a square shaped car park is 30 m. Find the area of the park.

The area of a square of side length $a = a^2$

$\therefore$ The area of the car park of side length 30 m $= 30 \times 30 \text{ m}^2$

$= 900 \text{ m}^2$

Example 3

The breadth of a rectangular plot of land of area equal to the area of another rectangular plot of land of length 12 m and breadth 3 m, is 4 m. Find the length of this plot of land.

The area of a rectangle of length l and breadth $b = lb$

The area of the rectangular plot of land of length 12 m and breadth 3 m $= 12 \times 3 \text{ m}^2$

$= 36 \text{ m}^2$

The length of the plot of land of breadth 4 m $= 36 \div 4 \text{ m}$

$= 9 \text{ m}$

Let us take the length of the rectangular plot of land as l.

$A = lb$

$36 = l \times 4$

$4l = 36$

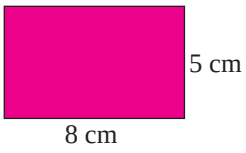
$l = \frac{36}{4} \text{ m} = 9 \text{ m}$

$\therefore$ the length of the plot of land is 9 m.

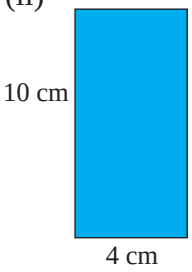
Exercise 17.2

(1) Find the area of each of the rectangular laminas given below.

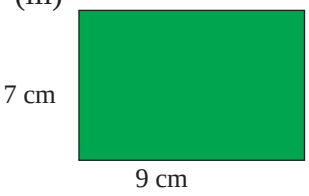
(i)



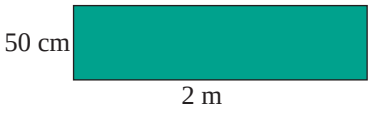
(ii)



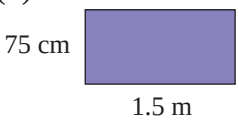
(iii)



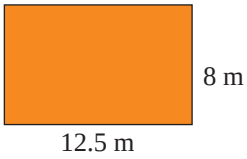
(iv)



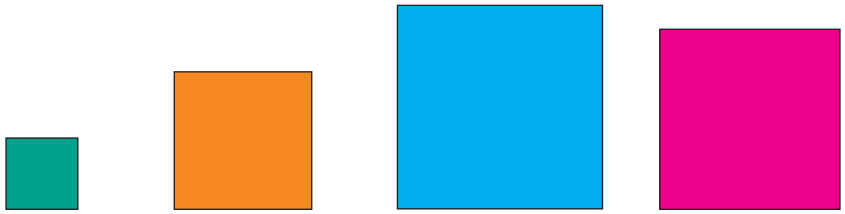
(v)



(vi)



(2) Find the area of each of the square laminas given below.



(3) The length of a rectangular plot of land is 9 m and its breadth is 4 m.

(i) Find the area of this plot of land.

(ii) Draw figures of two other plane shapes of the same area and mark the dimensions on the figure.

(4) The floor of a classroom takes the shape of a square of side length 10 m.

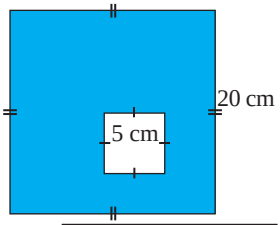
(i) Find the area of the floor of the classroom.

(ii) Another classroom which has the same area as the above classroom has a rectangular floor. If the breadth of the floor of this classroom is 5 m, find the length of the floor.

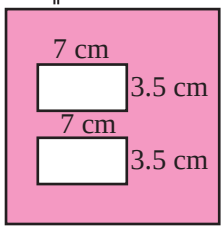
(5) The area of a flower bed is 36 m^2. An incomplete table containing the dimensions of several flower beds of the same area is given below. Copy and complete the table.

Length (m)	Breadth (m)	Area (m^2)	Shape of the flower bed	Perimeter of the flower bed
9	.....	36	Rectangle	.....
18	.....	36	.....	.....
12	.....	36	.....	.....
6	.....	36	.....	.....

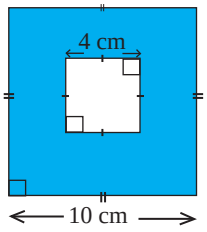
(6) The figure shows a shaded square shaped lamina of side length 20 cm within which a square shaped lamina of side length 5 cm has been shaded white. Find the area of the region shaded in blue in the figure.

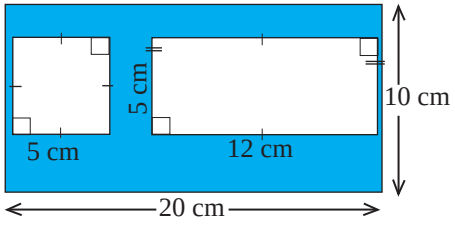


(7) Two rectangular shaped parts of length 7 cm and breadth 3.5 cm have been shaded in white in the square shaped piece of paper in the figure of area 616 cm^2. Find the area of the region shaded in pink.



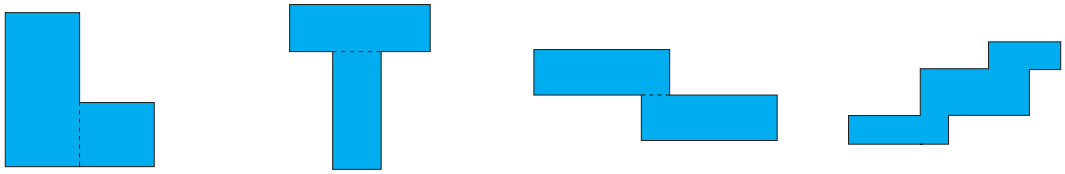
(8) Find the area of the shaded region in each of the following figures.





17.4 Areas of composite plane figures

Composite plane figures that can be divided into several rectangles are shown here.



Activity 3

Step 1 - From coloured paper, cut out the following shapes with the given dimensions.

- 3 rectangles of length 5 cm and breadth 4 cm
- 3 rectangles of length 6 cm and breadth 3 cm
- 3 rectangles of length 4 cm and breadth 1 cm
- 3 squares of side length 2 cm
- 3 squares of side length 3 cm

Step 2 - Find the area of each of the above plane figures and write it on the lamina.

Step 3 - Prepare 3 composite figures using 2 different laminas at a time and paste them in your exercise book.

Step 4 - Prepare another 3 composite figures using 3 different shapes at a time and paste them in your exercise book as well.

Step 5 - Find the areas of the pasted composite plane figures by considering the areas of the rectangles and squares prepared at the beginning of the activity, and write them next to the relevant composite figure.

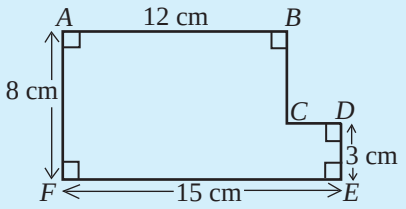
Step 6 - Write down the procedure of finding the area of a composite figure.

Based on the above activity, the procedure of finding the area of a composite plane figure can be expressed in 3 steps.

- Divide the composite figure into sections which are squares and of rectangles of which the area can be found.
- Find the area of each divided section.
- Find the sum of the areas.

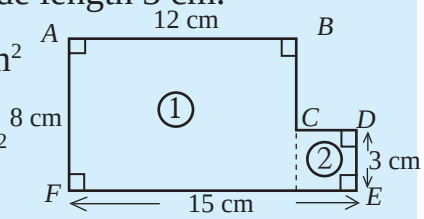
Example 1

Find the area of the figure *ABCDEF* based on the given measurements.



Method I

This figure can be divided into two sections as a rectangle of length 12 cm and breadth 8 cm and a square of side length 3 cm.



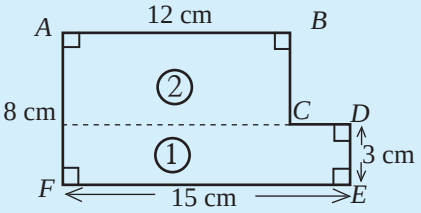
The area of rectangle ① $= 12 \times 8\ cm^2$
$= 96\ cm^2$

The area of square ② $= 3 \times 3\ cm^2$
$= 9\ cm^2$

$\therefore$ The area of the whole figure $= (96 + 9)\ cm^2$
$= 105\ cm^2$

Method II

The area of the above figure can also be found by dividing it into two rectangles, where one is of length 15 cm and breadth 3 cm and the other is of length 12 cm and breadth 5 cm.



The area of rectangle ① $= 15 \times 3\ cm^2$
$= 45\ cm^2$

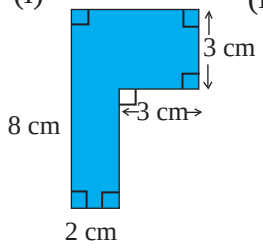
The area of rectangle ② $= 12 \times 5\ cm^2$
$= 60\ cm^2$

$\therefore$ The area of the whole figure $= 45 + 60\ cm^2$
$= 105\ cm^2$

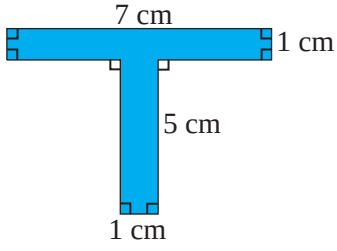
Exercise 17.3

(1) Several composite figures that can be separated into rectangles are shown here. Copy the given figures in your exercise book and find the area of each figure.

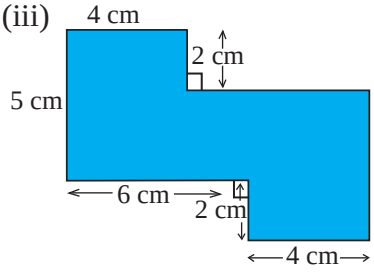
(i)



(ii)



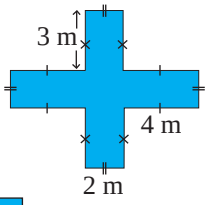
(iii)



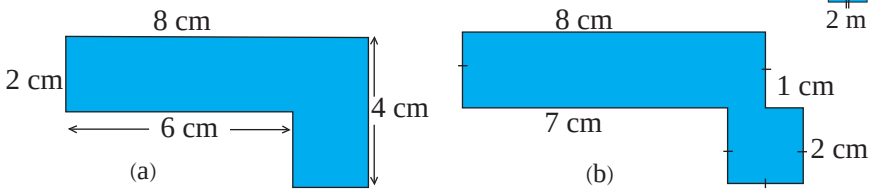
(2) Find the

(i) area and

(ii) perimeter of the given figure.



(3)



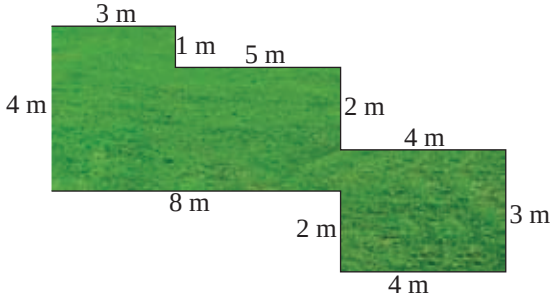
(i) Find the area of figure (a) and figure (b) separately.

(ii) Is the area of figure (a) equal to the area of figure (b)?

(iii) Find the perimeter of figure (a) and figure (b) separately.

(iv) Is the perimeter of figure (a) equal to the perimeter of figure (b)?

(4) Find the area of the plot of land given in the figure.



(5) It is proposed to lay tiles on a rectangular floor of length 6 m and breadth $4\frac{1}{2}$ m. It is required to select a suitable tile from a square tile of side length 30 cm and a square tile of side length 40 cm. The tiles are to be laid such that the edges of the tiles are parallel to the walls.

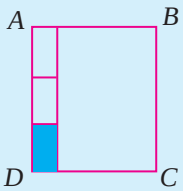
(i) Write down which tile you will select to avoid any wastage. Explain the reason for your selection.

(ii) Find the number of tiles that are required based on your selection.

17.5 Estimation of the areas of plane figures

Example 1

The area of the shaded region in the figure is 6 cm^2. Estimate the area of the rectangle *ABCD*.



Area of a thin strip = 6 × 3 cm^2 = 18 cm^2

There are about 5 thin strips.

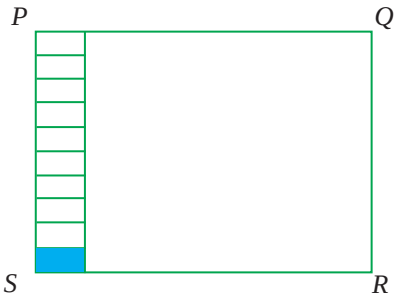
The area of 5 strips $= 18 \times 5 \text{ cm}^2$

$= 90 \text{ cm}^2$

$\therefore$ The area of the rectangle *ABCD* is approximately $= 90 \text{ cm}^2$

Exercise 17.4

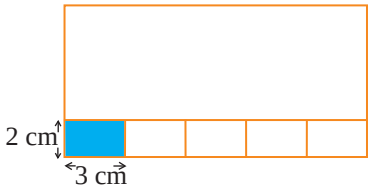
(1) *PQRS* is a rectangle. The area of the shaded region in the figure is 120 cm^2. Find an approximate value for the area of the rectangular lamina *PQRS*.



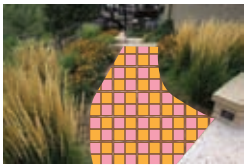
(2) Based on the information given in the figure,

(i) find the area of the shaded region.

(ii) estimate the area of the whole figure.



(3) It is required to lay concrete bricks along a straight road of breadth 4 m to a distance of 100 m. The top surface of a concrete brick is square shaped of side length 40 cm. Estimate the minimum number of concrete bricks required to pave the whole road.



Summary

- Square centimetre (cm^2) and square metre (m^2) are two units used to measure areas.
- The area of a rectangle of length l units and breadth b units is lb square units.
- The area of a square of side length a units is a^2 square units.