15   Length
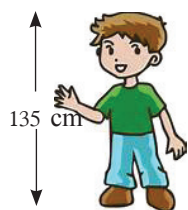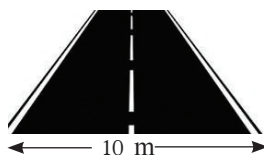
By studying this lesson, you will be able to,
- identify the units that are used to measure length,
- identify the relationship between the different units of measuring length and
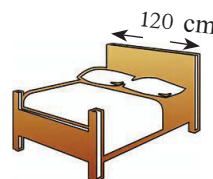- find the perimeter of a rectilinear plane figure.

15.1   Length, height, width, depth and thickness are indicators of length
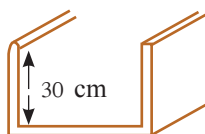

Ganesh's height is 135 cm.
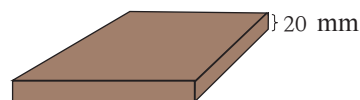
The width of the road is 10 m.

Width of the bed is 120 cm.

The depth of the fish tank is 40 cm .

The depth of the drain is 30 cm.

The thickness of a wooden plank is 20 mm.

In our day to day lives we come across this kind of information. In such instances the linear distance from one end to the other end is indicated.

The meaning of length is the linear distance from one end to the other end.

Accordingly height, width, depth and thickness also indicate lengths.

Furthermore, the length, width and thickness of a book indicate the various lengths associated with the book.

Exercise 15.1

(1) Write five examples for situations where information is given using each of the following.

   (i) Height   (ii) Depth
   (iii) Width   (iv) Thickness

15.2 Measuring tools and units of measurement

Some measuring tools that are used to measure lengths are shown below.

Look at your 15 cm ruler. The sixteen long lines with equal gaps between them are marked as 0, 1, 2, 3, ... 15. The gap between every two long lines is again divided into 10 similar parts using short lines.

The distance between each two long lines on the ruler is 1 centimetre.

The distance between each two short lines is 1 millimetre.

That is, one centimetre is 10 millimetres.

One centimetre is written as 1cm, and 1 millimetre is written as 1 mm.

So, **10 mm = 1cm**

Look at the metre ruler and measuring tapes of different lengths that are given to you. You will notice that in those tools also there are numbers such as 0, 1, 2… and lines.

Check carefully as to how many centimetres are marked on the metre ruler. You will notice that it has numbers marked from 0 centimetres to 100 centimetres. The length of a hundred centimetre is one metre. One metre is written as 1 m.

That is **100 cm = 1 m**

The ruler having a length of one metre is called the metre ruler. Check carefully as to how many metres are marked on a measuring tape.
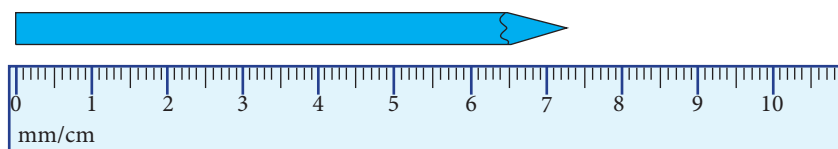
Now you can identify measuring tapes of different lengths.

The distance between two towns or the length of a highway is measured in kilometres. A length of 1000 metres is one kilometre. One kilometre is written as 1 km.

That is **1000 m = 1 km**

15.3 Measuring lengths

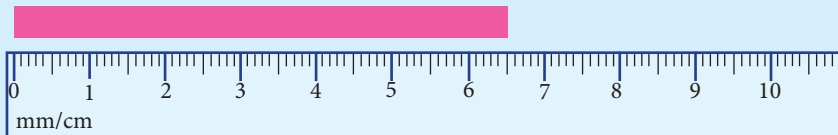The diagram below shows how the length of a pencil is measured using a ruler.

One end of the pencil is placed at the zero line . The sharpened end of the pencil is at 7 cm and three short lines.

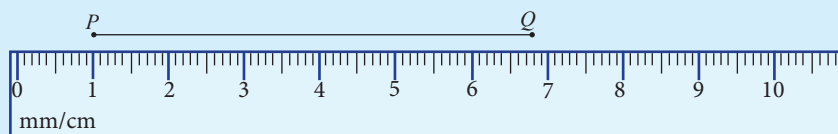So , the length of the pencil is 7 cm 3 mm.

Example 1

The diagram shows how the length of a strip of paper is measured using a ruler.

What is the length of the strip of paper?

The length of the strip of paper is 6 cm 5 mm.

Example 2

What is the length of PQ in the diagram shown above?

The point Q is at 6 cm 8 mm.
Since the point P is at 1 cm, the length of the line is 1 cm less than 6 cm 8 mm.
So the length of the line PQ is 5 cm 8 mm.

Exercise 15.2

(1)　(i) The table below gives some activities in our daily life which involve measuring length. Copy the table.

　(ii) Write four more examples of activities in our daily life which involve measuring length in the table.

　(iii) Complete the table by writing suitable measuring tools or instruments and units of measurement.

Activity	Suitable measuring tools or instruments	Unit
1. To measure the length of a straight line drawn in your exercise book		
2. To measure the depth of a drinking glass		
3. To measure the thickness of a wooden plank		
4. To measure the length of a school building		
5. To measure the width of the drain		
6. To measure the height of a wall		
7.		
8		
9		
10		

(2) What is the length of each of the straight lines shown below?

    (i) ————————————————

    (ii) ———————————————

    (iii) ——————————————————————

(3) Measure and write the length and the width of the given rectangle.

(Note: The length of the longer side of the rectangle is considered as its length and the length of the shorter side is considered as its width).
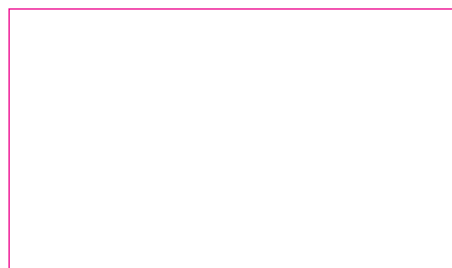
(4) Measure and write down the thickness of a five rupee coin.

(5) Use the metre ruler and take measurements of
  (i)   the length and the width of the teacher's table.
  (ii) the length and the width of the class room.
  (iii) the length and the width of the black board.
  (iv) the depth of a gutter or a pit.
  (v)   the height from the ground to the bottom edge of the blackboard.

(6) The diagram below shows a piece of chalk.
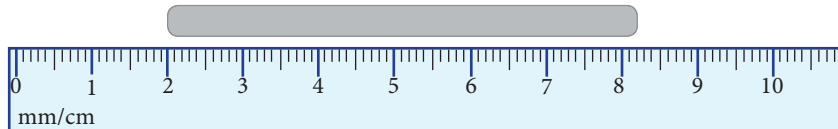
Your friend says that the piece of chalk shown above has a length of 8 cm 2 mm. Do you agree with your friend? Explain your answer giving reasons.

15.4 Relationships between the different units of measuring length

We have learnt that millimetre, centimetre and metre are some units that are used to measure length. Now let us discuss the relationships between these units.

• Relationship between a millimetre and a centimetre

By observing the 15 cm ruler you identified that a length of 10 millimetres is indicated as one centimetre.

$$10 \text{ mm} = 1 \text{ cm}$$

Therefore, $1 \text{ mm} = \dfrac{1}{10} \text{ cm}$

In the lesson on decimals you learnt that $\dfrac{1}{10} = 0.1$.

Therefore , 1 mm = 0.1 cm

Now let us consider how we express a length given in centimetres, in terms of millimetres.

$$\text{Since } 1 \text{ cm} = 10 \text{ mm},$$
$$2 \text{ cm} = 20 \text{ mm}$$
$$3 \text{ cm} = 30 \text{ mm}$$

To express the length given in centimetres in terms of millimetres, the number of centimetres needs to be multiplied by ten.

Now let us consider how we express a length given in millimetres in terms of centimetres.

$$\text{Since } 10 \text{ mm} = 1 \text{ cm},$$
$$20 \text{ mm} = 2 \text{ cm}$$
$$30 \text{ mm} = 3 \text{ cm}$$

To express the length given in millimetres in terms of centimetres, the number of centimetres needs to be divided by ten.

Example 1	Example 2
Express 8 cm, in millimetres.	Express 60 mm in centimetres.
8 cm = 8 × 10 mm	10 mm = 1 cm
= 80 mm	$60 \text{ mm} = \dfrac{60}{10} \text{ cm}$

Example 3

= 6 cm

Express 27 mm in centimetres and millimetres.

27 mm = 20 mm + 7 mm

Since 10 mm = 1 cm, 20 mm = 2 cm

27 mm = 2 cm + 7 mm

27 mm = 2 cm 7 mm

Accordingly, to express a length of 10 mm or more, in terms of centimetres and millimetres, the amount of millimetres is written as lesser than 10.

Example 4

Express 0.7 cm
in millimetres.

$1 \text{ cm} = 10 \text{ mm}$
$0.1 \text{ cm} = 1 \text{ mm}$
$0.7 \text{ cm} = 7 \text{ mm}$

Example 5

Express 35 mm in centimetres.

$10 \text{ mm} = 1 \text{ cm}$

$35 \text{ mm} = 30 \text{ mm} + 5 \text{ mm}$

$= 3 \text{ cm} + \dfrac{5}{10} \text{ cm}$

$= 3 \text{ cm} + 0.5 \text{ cm}$

$= 3.5 \text{ cm}$

Example 6

Express 5.3 cm, in millimetres.

$5.3 \text{ cm} = 5 \text{ cm} + 0.3 \text{ cm}$

Since $5 \text{ cm} = 50 \text{ mm}$ and $0.3 \text{ cm} = 3 \text{ mm}$,

$5.3 \text{ cm} = 50 \text{ mm} + 3 \text{ mm}$

$= 53 \text{ mm}$

Example 7

In Parami's pencil box, there are several pencils.

The length of the red pencil is 13.3 cm.

The length of the blue pencil is 138 mm.

The length of the yellow pencil is 12 cm 8 mm.

Out of these pencils, which one is the longest? Explain your answer.

Let's write the lengths of the 3 pencils in the same unit.

The length of the red pencil $= 13.3 \text{ cm}$

$= 13 \text{ cm} + 0.3 \text{ cm}$

$= 130 \text{ mm} + 3 \text{ mm}$

$= 133 \text{ mm}$

The length of the blue pencil $= 138 \text{ mm}$

The length of the yellow pencil $= 12 \text{ cm } 8 \text{ mm} = 120 \text{ mm} + 8 \text{ mm}$

$= 128 \text{ mm}$

Since 138 is the largest number out of 133, 138 and 128, the blue pencil is the longest pencil.

(1) Express each of the following lengths given in centimetres, in terms of millimetres.

(i) 40 mm   (ii) 240 mm   (iii) 280 mm
(iv) 70 mm   (v) 450 mm   (vi) 100 mm

(2) Complete the blanks below.

(i) 8 cm 4 mm = 8 cm + ...mm   (ii) 15 cm 8 mm = ... cm + 8 mm
                      = ... mm + ...mm   = ... mm + ... mm
                      = ...mm   = ... mm

(iii) 35 cm 7 mm = ... cm + ...mm
                = ... mm + ...mm
                = ... mm

(3) Express each of the following lengths given in centimetres, in terms of millimetres.

(i) 7 cm   (ii) 15 cm   (iii) 5 cm 4 mm
(iv) 22 cm 5 mm   (v) 8.6 cm   (vi) 0.4 cm

(4) Express each of the following lengths given in millimetres, in terms of centimetres and millimetres.

(i) 12 mm   (ii) 138 mm   (iii) 235 mm   (iv) 301 mm

(5) Express each of the following lengths given in millimetres in terms of centimetres.

(i) 25 mm   (ii) 3 mm   (iii) 123 mm

(6) Nethmi's middle finger is 5.8 cm long. Amaya's middle finger is 57 mm long. Amali's middle finger is 5 cm 9 mm long.

(i) Write the lengths of the middle fingers of Nethmi, Amali and Amaya in millimetres.
(ii) Who has the longest middle finger? Explain your answer.

(7) The lengths of 3 straight line segments are as below.

The length of the first straight line is 18 cm.
The length of the second straight line is 195 mm.
The length of the third straight line is 18 cm and 7 mm.

(i) Write the length of each straight line segment above in millimetres.
(ii) Which is the shortest line segment?

(8) Three students measured the length of a pencil. Their records are as follows.

Gayan wrote 133 mm as the length.
Suresh wrote 13 cm and 3 mm as the length.
Asith wrote 13.3 cm as the length.
Explain with reasons that the three students have obtained the same measurement.

● **Relationship between a centimetre and a metre.**

When we observe a tape or a metre ruler, we see that a length of 100 cm is 1 m.

Since 100 cm = 1m,

$$1 \text{ cm} = \frac{1}{100} \text{ m}$$

Since $\frac{1}{100}$ = 0.01, 1 cm = 0.01 m

Now let us consider how we express a length given in metres, in terms of centimetres.
Since 1 m = 100 cm,
2 m = 200 cm
3 m = 300 cm

Accordingly, to express a length given in metres in terms of centimetres, the number of metres needs to be multiplied by 100.

Now let us express a length given in centimetres, in terms of metres.
Since 100 cm = 1 m,
      200 cm = 2 m
      300 cm = 3 m

Accordingly, to express a length given in centimetres in terms of metres, the number of centimetres needs to be divided by 100

Example 1

Express 7 m in centimetres.
Since 1 m = 100 cm,
    7 m = 100 × 7 cm
       = 700 cm

Example 2

Express 6 m and 23 cm in centimetres.
6 m 23 cm = 6 m + 23 cm
          = 600 cm + 23 cm
          = 623 cm

Example 3

Express 800 cm in metres.
100 cm = 1 m

$$800 \text{ cm} = \frac{800}{100} \text{ m}$$

        = 8 m

Example 4

Express 875 cm in metres and centimetres.
875 cm = 800 cm + 75 cm
Since 800 cm = 8 m,
875 cm = 8 m + 75 cm
       = 8 m 75 cm

Accordingly, to express a length of 100 cm or more, in terms of metres and centimetres the number of centimetres is written as lesser than 100.

Example 5

Express 7.85 m in centimetres.
7.85 m = 7 m + 0.85 m
      = 700 cm + 85 cm
      = 785 cm

Example 6

Express 54 cm in metres.
$$54 \text{ cm} = \frac{54}{100} \text{ m}$$

Since $\frac{54}{100} = 0.54$,

54 cm = 0.54 m

Exercise 15.4

(1) Write each of the lengths below in centimetres.

    (i) 10 m   (ii) 675 m   (iii) 2 m 25 cm
    (iv) 8 m 18 cm   (v) 6.95 m   (vi) 11.08 m

(2) Write each of the lengths below in metres and centimetres.

    (i) 105 cm   (ii) 318 cm   (iii) 1508 cm
    (iv) 20 001 cm   (v) 1025 cm

(3) Write each of the lengths below in metres.

    (i) 100 cm   (ii) 500 cm   (iii) 1100 cm
    (iv) 25 000 cm   (v) 96 cm   (vi) 49 cm
    (vii) 125 cm   (viii) 1349 cm

(4) The heights of three students are given below.

$$\text{Height of Anjula } = \text{ 156 cm}$$
$$\text{Height of Saranga } = \text{ 1 m 53 cm}$$
$$\text{Height of Supun } = \text{ 1.6 m}$$

    (i) Write the height of each student in centimetres.
    (ii) Who is the tallest student?

(5) Pubudini has a red ribbon one and a half metres long, a blue ribbon 105 cm long and a white ribbon 1 m and 55 cm long.

    (i) What is the colour of the longest ribbon?
    (ii) Explain how you obtained the answer.

(6) Three workers A, B and C were digging a drain. The depth of the drain completed by each worker is given below.

    $A - 1.8$ m
    $B - 108$ cm
    $C - 1$ m 18 cm

Which worker has done the least amount of digging? Explain your answer.

(7) Minraj threw a stone a distance of 1830 cm. Dinuraj threw the same stone a distance of 18.03 m. Kavishka says that Minraj threw the stone a longer distance than Dinuraj did. Do you agree with Kavishka? Give reasons for your answer.

• The relationship between a metre and a kilometre

Now let us express a length given in kilometres in terms of metres.

Since   1 km = 1000 m,

2 km = 2000 m

3 km = 3000 m

Accordingly, to express a length given in kilometres in terms of metres, the number of kilometres needs to be multiplied by 1000.

Now let us express a length given in metres, in terms of kilometres.

Since 1000 m = 1 km,

2000 m = 2 km

3000 m = 3 km

Accordingly, to express a length given in metres in terms of kilometres, the number of metres needs to be divided by 1000.

Example 1

Express 5 km in metres.

1 km   = 1000 m

5 km   = 1000×5 m

           = 5000 m

Example 2

Express 3 km 750 m in metres.

3 km 750 m = 3 km + 750 m

             = 3000 m + 750 m

             = 3750 m

Example 3

Express 5000 m in kilometres.

5000 m = $\dfrac{5000}{1000}$ km

5000 m = 5 km

Example 4

Express 3725 m, in kilometres and metres.

3725 m = 3000 m + 725 m

3000 m = $\dfrac{3000}{1000}$ km = 3 km

3725 m = 3 km + 725 m

           = 3 km 725 m

Accordingly, to express a length of 1000 m or more, in terms of kilometres and metres, the number of metres is written as lesser than 1000.

Exercise 15.5

(1) Express each of the distances given below in metres.

(i) 3 km   (ii) 16 km   (iii) 15 km 25 m   (iv) 2 km 750 m

(2) Express each of the distances given below in kilometres.

    (i) 3000 m   (ii) 12000 m   (iii) 25000 m   (vi) 500 m

(3) Express each of the distances given below in kilometres and metres.

    (i) 3715 m   (ii) 1005 m   (iii) 2030 m
    (iv) 15 120 m   (v) 20 225 m

(3) Naveen, Gayan and Kasun took part in the Marathon at the school sports meet. Naveen had run 1850 m, Gayan had run 1 km 800 m and Kasun had run 1 km 90 m in ten minutes.

    (i)   Express the distance run by each student in metres.

    (ii)   Which athlete is ahead of the other two? Give reasons for your answer.

15.5 Estimating the length

Let us understand the estimation of length through the following examples.

A linear fence has 27 poles fixed to it . The distance between two poles which are next to each other is about 2 m. Estimate the total length of the fence.

2 m

The distance between two poles is about 2 m.

The number of spaces in between 27 poles   = 26

            Estimated length of the fence   = 2 × 26 m
                                     = 52 m

Exercise 15.6

(1) A wooden plank has a thickness of about 2 cm. 67 such planks are arranged one on top of the other. Estimate the height of the set of planks.

(2) In the staircase shown here, one step has a height of about 15 cm. Estimate the vertical distance travelled by a person who has climbed to the top of the stair case? Give your answer in meters.

} 15 cm
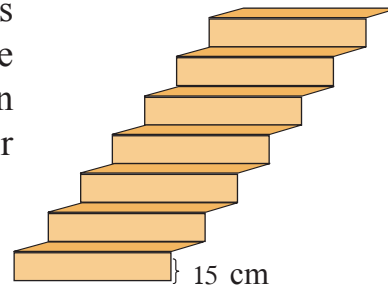
(3) The photograph here shows a pile of books. Twenty such piles are to be kept on a rack, having a height of 2 m. Explain whether this can be done.
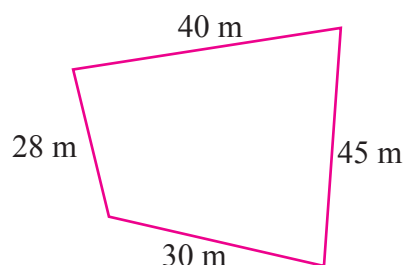
15 cm

15.6 Perimeter

A man decides to put up a wire fence around his plot of land.
Let us calculate the length of a single strand of wire needed to build the fence.

40 m

28 m

45 m

30 m

This diagram shows the lengths of the four sides of the plot of land.
The length around the land
= 40 m + 28 m +30 m + 45 m
= 143 m

The length of a single strand of wire needed to build the fence is 143 m.

This type of calculation is needed when we arrange bricks around a flower bed, build a wall around a plot of land and construct a frame for a picture.

The perimeter of a plane figure is the sum of the lengths of the sides of that figure.

Let us find the perimeter of plane figures.

The picture below shows a wall hanging. A ribbon has to be sewn around it. Let us find the length of this ribbon.

The length of this ribbon = 68 cm 7 mm + 68 cm 7 mm + 60 cm 4 mm

60 cm 4 mm
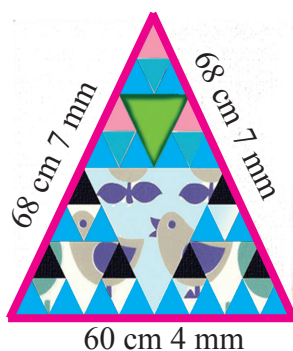
Let us find out how to add these numbers.

cm	mm
68	7
68	7
+ 60	4
197	8

Step 1 - Let us add the numbers in the millimetre column separately.

7 mm + 7 mm + 4 mm = 18 mm.

18 mm = 10 mm + 8 mm

= 1 cm + 8 mm

Let us write 8 mm in the millimetre column. Let us carry the 1 cm to the centimetre column.

Step 2 - Let us add the numbers in the centimetre column.

1 cm + 68 cm + 68 cm + 60 cm = 197 cm

So the length of the ribbon is 197 cm and 8 mm.
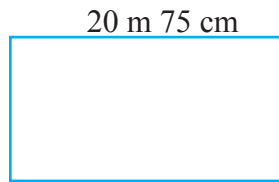
20 m 75 cm

A certain ground has a rectangular shape (See figure). Its length is 20 m 75 cm and its width is 12 m 60 cm. We need to find the perimeter of the ground.

12 m 60 cm

First, let us add the two lengths together.

m	cm
20	75
+ 20	75
41	50

Let us add the numbers in the centimetre column. It is

75 cm + 75 cm = 150 cm

150 cm = 100 cm + 50 cm

150 cm = 1 m + 50 cm

Let us write the 50 cm in the centimetre column. Now let us add the 1 m we obtained here to the numbers in the metre column.

1 m + 20 m + 20 m = 41 m

So the sum of the two lengths is 41 m 50 cm.
Similarly let us add the two widths.

m	cm
12	60
+ 12	60
25	20

We need to add the two lengths and the two widths to find the perimeter.

m	cm
41	50
+ 25	20
66	70

So the perimeter is 66 m 70 cm.

Example 1
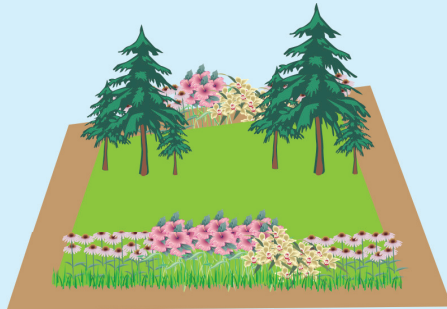
Every morning, Nimali walks one round around the park. Find the total distance she walks around the park in two days.

115 m 87 cm

112 m 50 cm

110 m 68 cm

119 m 95 cm
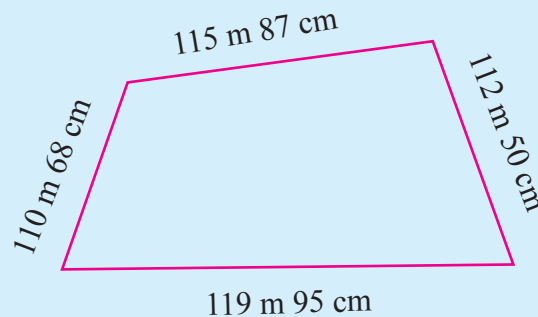
We need to find the distance around the park, in order to find the required distance. So let us find the sum of the lengths of the four sides of the park.

m	cm
115	87
119	95
112	50
110	68
459	00

Let us add the numbers in the centimetre column.
It is $87 + 95 + 50 + 68 = 300$
Since 300 cm = 3 m, let us write zero in the centimetre column.
Let us carry the 3 m to the metre column.
$115 + 119 + 112 + 110 + 3 = 456$

Therefore, the distance Nimali walks around the park in a day is 459 m.

So the distance Nimali walks around the park in two days $\Big\}$ = 459 m + 459 m

= 918 m

Example 2

The width of a rectangle is 12 cm. Its lengths is twice its width. Find the perimeter of the rectangle.

Let us draw a sketch and mark the given data.
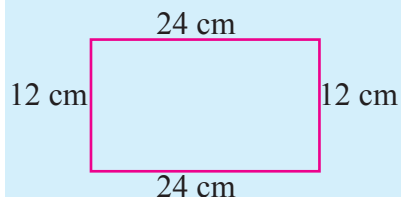
24 cm

12 cm   12 cm

24 cm

Consider the scale roughly.

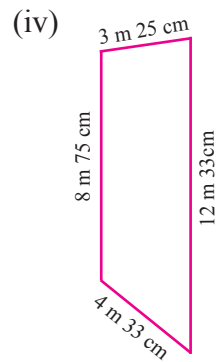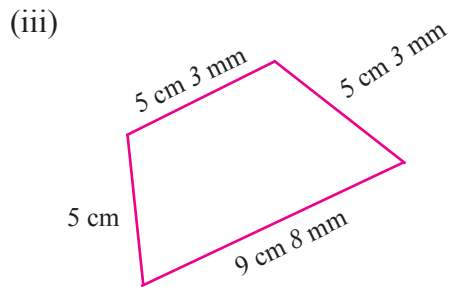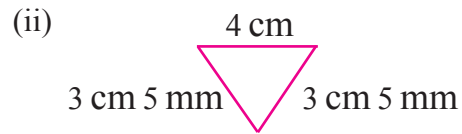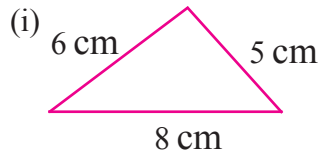The perimeter of the rectangle
= 24 cm + 12 cm + 24 cm +12 cm
= 72 cm

Exercise 15.7

(1) Consider the square grid below. The length of a side of a square given in dark lines is 1 cm. Find the perimeter of each of the coloured figures drawn on the grid.
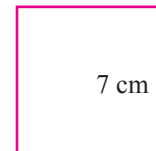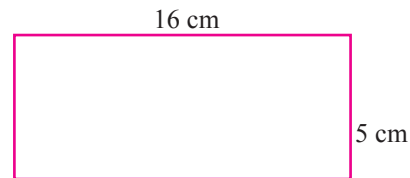
(i)
(ii)
(iii)
(iv)

(2) Find the perimeter of each of the figures below.

(i)

6 cm   5 cm
8 cm

(ii)

4 cm
3 cm 5 mm   3 cm 5 mm

(iii)

5 cm 3 mm   5 cm 3 mm
5 cm
9 cm 8 mm

(iv)

3 m 25 cm
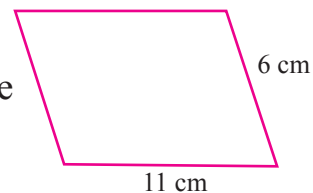8 m 75 cm   12 m 33 cm
4 m 33 cm
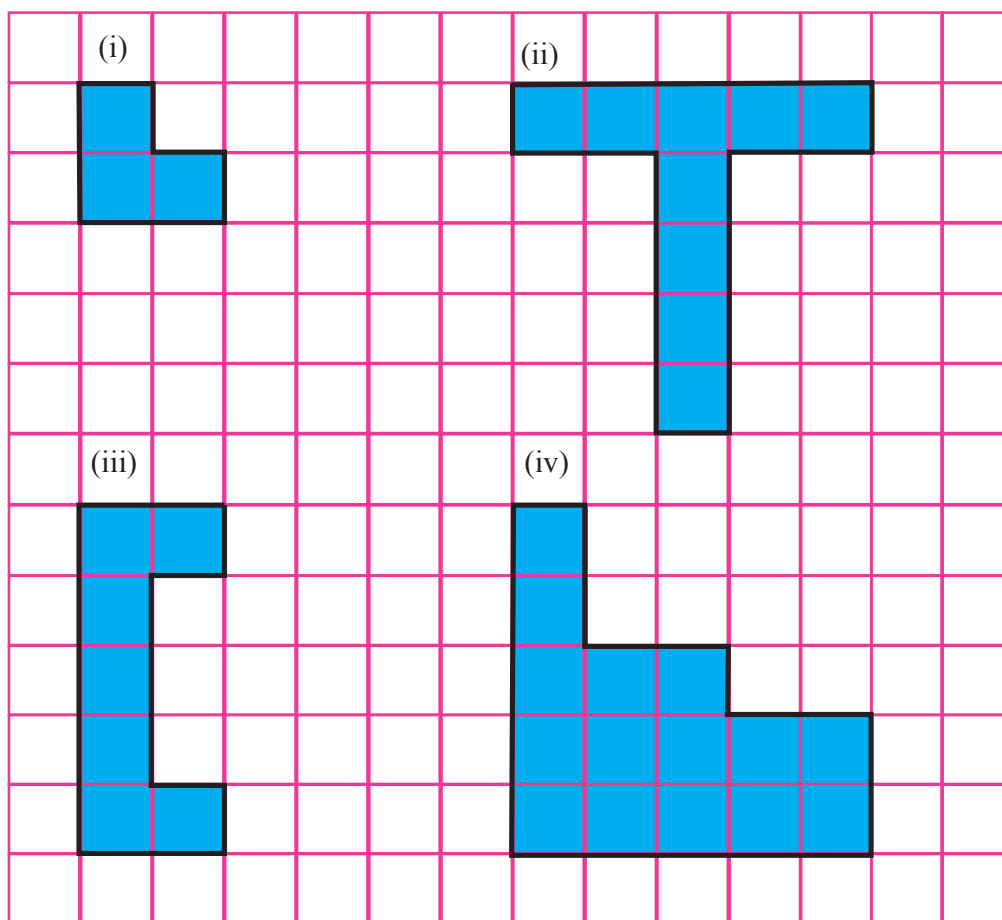
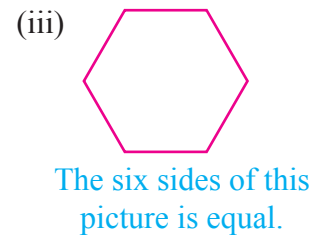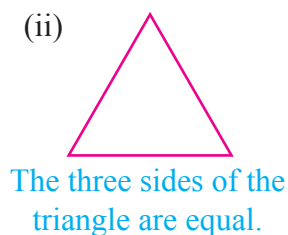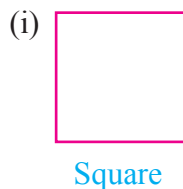(3) Find the perimeter of the square in the picture.

7 cm

(4) A rectangle is shown here. Find its perimeter.

16 cm
5 cm

(5) Find the perimeter of the parallelogram in the picture.

6 cm
11 cm

(6) The perimeter of each of the figures below is 24 cm. Find the length of a side of each figure.

(i)

Square

(ii)

The three sides of the triangle are equal.

(iii)

The six sides of this picture is equal.

(7) A rectangular plot of land has a length of 50 m and a width of 45 m. A wire fence is to be put up around it. Find the length of a single strand of wire needed to build the fence.

(8) The length of a rectangle is 7 cm. If it's perimeter is 20 cm then what is it's width?

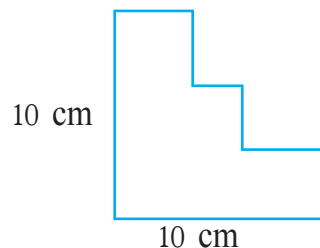(9) The rectangular wall hanging shown below is to be decorated by pasting a coloured ribbon around it.

Chitra says that one and a half metres of coloured ribbon is enough for the decoration. Do you agree with her? Explain your answer.

50 cm

30 cm

(10) Find the perimeter of the figure shown here.

10 cm

10 cm

Summary

- Units such as mm, cm, m, km can be used as required to denote lengths.
-
    1 cm = 10 mm
    1 m = 100 cm
    1 km = 1000 m
- The perimeter of a plane figure is the sum of the lengths of the sides of that figure.