16 Length

By studying this lesson you will be able to

- add and subtract length measurements,
- multiply and divide length measurements by a whole number, and
- find the perimeter of a rectilinear plane figure.

16.1 Units of length

All the words, height, depth, width and thickness describe a certain length. You have already learnt that the units millimetre (mm), centimetre (cm), metre (m) and kilometre (km) are used to measure lengths. The relationships between these units are given below.

1 centimetre	= 10 millimetres
1metre	= 100 centimetres
1 kilometre	= 1000 metres

1 cm	= 10 mm
1 m	= 100 cm
1 km	= 1000 m

You have also learnt to convert a length given in a certain unit to another unit using the above relationships. Do the following review exercise to revise what you have learnt.

Review Exercise

(1) Fill in the blanks.

(i) 13 mm = 10 mm + ... mm
= ..... cm + ... mm
= 1.3 cm

(ii) 45 mm = ... cm ..... mm
= ..... cm

(iii) 728 cm = ... m ..... cm
= ..... m

(iv) 7075 m = ... km ..... m
= ..... km

(v) 305 mm = ... cm

(vi) 150 cm = ... m

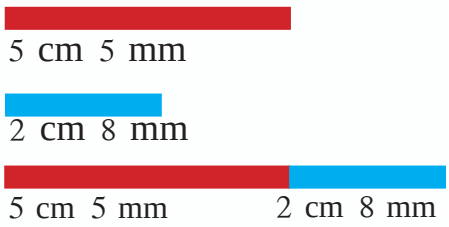
(vii) 1540 m = ... km

(viii) 5.3 cm = ... mm

(ix) 3.25m = ... cm

(x) 2.375 km = ... m

16.2 Addition of length measurements



The figure shows two ribbons, one red and the other blue. The red ribbon is of length 5 cm 5 mm. The blue ribbon is of length 2 cm 8 mm. The figure also shows the two ribbons pasted on a piece of paper such that one end of the blue ribbon touches one end of the red ribbon. Let us find the length of the pasted ribbon.

To do this we need to add the lengths of the two ribbons.

Method I

cm	mm
5	5
+ 2	8
8	3

Let us add the quantities in the millimetres column.
5 mm + 8 mm = 13 mm
13 mm = 1 cm + 3 mm
Let us write 3 mm in the millimetres column and carry the 1 cm to the centimetres column.
Then, 1 cm + 5 cm + 2 cm = 8 cm
Let us write 8 cm in the centimetres column.

So, the total length is 8 cm and 3 mm.

Method II

Let us express each of the length measurements in centimetres, and then simplify.

5 cm 5 mm = 5.5 cm
2 cm 8 mm = 2.8 cm
8.3 cm = 8 cm 3 mm

cm
5 . 5
+ 2 . 8
8 . 3

- Let us simplify 5 m 65 cm + 15 m 70 cm.

Method I

m	cm
5	65
+ 15	70
21	35

Let us add the quantities in the centimetres column.
65 cm + 70 cm = 135 cm
135 cm = 1 m + 35 cm
Let us write the 35 cm in the centimetres column and carry the 1 m to the metres column.
Then, 1 m + 5 m + 15 m = 21 m
Let us write 21 m in the metres column.

Method II

Let us express each of the length measurements in metres, and then simplify.

5 m 65 cm = 5.65 m

15 m 70 cm = 15.70 m

21.35 m = 21 m 35 cm

	m
	5 . 65
+	15 . 70
	21 . 35

- Let us simplify 3 km 30 m + 980 m .

Method I

	km	m
	3	30
+		980
	4	10

Let us add the quantities in the metres column.
30 m + 980 m = 1010 m
1010 m = 1 km + 10 m
Let us write the 10 m in the metres column and carry the 1 km to the kilometres column.
3 km + 1 km = 4 km
Let us write the 4 km in the kilometres column.

Method II

Let us express each of the length measurements in kilometres, and then simplify.

3 km 30 m = 3.030 km

980 m = 0.980 km

4.010 km = 4 km 10 m

	km
	3 . 030
+	0 . 980
	4 . 010

Example 1

Simplify 12 m 70 cm + 8 m 5 cm + 15 m 80 cm.

Method I

	m	cm
	12	70
	8	05
+	15	80
	36	55

Method II

12 m 70 cm = 12.70 m

8 m 5 cm = 8.05 m

15 m 80 cm = 15.80 m

	m
	12 . 70
+	8 . 05
	15 . 80
	36 . 55

36.55 m = 36 m 55 cm

Exercise 16.1

(1) Simplify the following.

(i)

	cm	mm
	5	6
+	12	3

(ii)

	cm	mm
	13	6
+	17	8

(iii)

	m	cm
	4	35
+	7	80

(iv)

	km	m
	3	70
+	1	5

(v) 2 km 780 m + 1 km 530 m

(vi) 57 cm 8 mm + 8 cm 7 mm + 12 cm 7 mm

(vii) 8 m 53 cm + 7 m 75 cm + 4 m 2 cm

(viii) 1 km 730 m + 4 km 20 m + 950 m

(2) Nipuna travels 1 km and 370 m from his house to the bus halt by bicycle. From there he travels 5 km and 680 m to school by bus. Find the total distance Nipuna travels when going to school from his house.

(3) A ribbon is cut into 3 pieces in order to make a wall hanging.

First piece - 12 cm 8 mm
Second piece - 8 cm 4 mm
Third piece - 4 cm

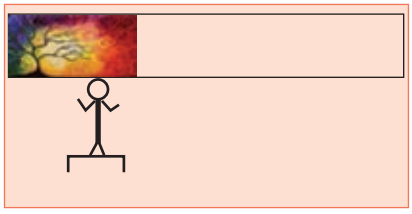
In order to cut all the above pieces, what is the minimum length of the ribbon that is required?

(4) There are three iron rods of the same type of length 1 m 23 cm, 2 m 9 cm and 1 m 73 cm respectively. A new rod can be made by selecting two of these rods and soldering them together without altering their original lengths.

(i) Find the length of the longest rod that can be made in this manner.

(ii) Find the length of the shortest rod that can be made in this manner.

16.3 Subtraction of lengths



- The length of a classroom wall is 5 m 50 cm. It has been decided to draw a picture along the top edge of the wall. On a particular day, the picture is drawn to a length of 1 m 80 cm. Let us find the remaining length of the wall on which the picture needs to be drawn.

To do this we need to subtract the length of the picture drawn from the length of the entire wall.

Method I

5 m 50 cm = 5. 50 m

1 m 80 cm = 1. 80 m

5 m 50 cm − 1 m 80 cm = 3.70 m

= 3 m 70 cm

m
5 . 50
− 1 . 80
3 . 70

So the length of the wall remaining on which the picture has to be drawn is 3 m 70 cm.

Method II

m	cm
5	50
− 1	80
3	70

50 is less than 80. So let us carry over 1 m from the 5 m in the metres column to the centimetres column.
Then 4 m will remain in the metres column.
100 cm + 50 cm = 150 cm
150 cm − 80 cm = 70 cm
Let us write 70 cm in the centimetres column.
Now let us reduce 1 m from the 4 m in the metres column.
4 m − 1 m = 3 m
Let us write 3 m in the metres column.

So the length of the wall remaining on which the picture has to be drawn is 3 m 70 cm.

Example 1

A piece of length 7 cm 5 mm is cut from a ribbon of length 32 cm 3 mm. What is the length of the remaining piece of ribbon?

Let us simplify 32cm 3mm − 7 cm 5 mm.

Method I

cm	mm
32	3
− 7	5
24	8

3 is less than 5. Let us carry over 1 cm from the 32 cm in the centimetres column to the millimetres column. Then there will be 31 cm remaining in the centimetres column.
10 mm + 3 mm = 13 mm
13 mm − 5 mm = 8 mm
Let us write 8 mm in the millimetres column.
From the remaining 31 cm in the centimetres column, let us subtract 7 cm.
31 cm − 7 cm = 24 cm

Method II

Let us express each of the length measurements in centimetres, and then simplify.

32 cm 3 mm = 32.3 cm

7 cm 5 mm = 7.5 cm

cm
32 . 3
− 7 . 5
24 . 8

Length of the remaining piece of ribbon is 24.8 cm = 24 cm 8 mm

Example 2

Simplify 6 km 50 m − 2 km 700 m.

Method I

km	m
6	50
− 2	700
3	350

50 is less than 700. Let us carry over 1 km from the 6 km in the kilometres column to the metres column.

1000 m + 50 m = 1050 m

1050 m − 700 m = 350 m

Let us write 350 m in the metres column. From the remaining 5 km, in the kilometres column, let us subtract 2 km.

5 km − 2 km = 3 km

Let us write 3 km in the kilometres column.

Method II

6 km 50 m = 6.050 km

2 km 700 m = 2.700 km

3.350 km = 3 km 350 m

km
6 . 050
− 2 . 700
3 . 350

Exercise 16.2

(1) Simplify.

(i) 10 cm 8 mm − 2 cm 5 mm

(ii) 15 cm 5 mm − 9 mm

(iii) 7 m 85 cm − 4 m 75 cm

(iv) 75 m 5 cm − 57 m 85 cm

(v) 12 km 300 m − 8 km 500 m

(vi) 24 km 75 m − 15 km 350 m

(2) Ruvini is 1 m 35 cm tall. Gayani is 1 m 48 cm tall. By how many centimetres is Gayani taller than Ruvini?

(3) From a piece of cloth of length 35 m in a shop, a length of 20 m 80 cm was sold. Find the length of the remaining cloth.

(4) A water tank is 1 m 30 cm deep. Water is filled to a height of 80 cm in this tank. We want to fill the tank completely. To do this, what is the height the water that must be added now?

(5) A worker is assigned to dig a trench of length 15 m. On a particular day he digs a length of 3 m 40 cm. Find the length of the trench remaining for him to dig.

(6) During an inter house sports meet of a school, it was required to run a distance of 10 km for the marathon. Nisham participated in this event. After running a distance of 8 km 850 m, he was injured and could not complete the race. Find the remaining distance that Nisham should have run to complete the race.

16.4 Multiplication and division of measurements of length

• Multiplication of a measurement of length by a whole number

➢ A ribbon of length 1 m 80 cm is required to decorate a present. Let us find the length of ribbon required to decorate 8 presents.

To do this, we need a ribbon which is of length eight times that of the piece of ribbon that is required to decorate one present. So 1 m 80 cm must be multiplied by 8.

Method I

m	cm
1	80
×	8
14	40

80 cm × 8 = 640 cm

Since 640 cm = 6 m 40 cm,

let us write the 40 cm in the centimetres column and carry the 6 m to the metres column.

1 m × 8 = 8 m.

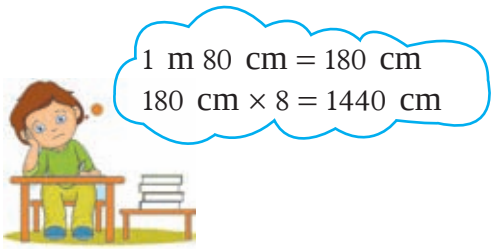
Let us add the 8 m to the 6 m.

8 m + 6 m = 14 m

Let us write the 14 m, in the metres column.

Method II

Let us express 1 m 80 cm, in centimetres and then multiply by 8.



cm
180
× 8
1440

Therefore the total length = 1440 cm = 14 m 40 cm

➢ Let us simplify 3 cm 7 mm × 5.

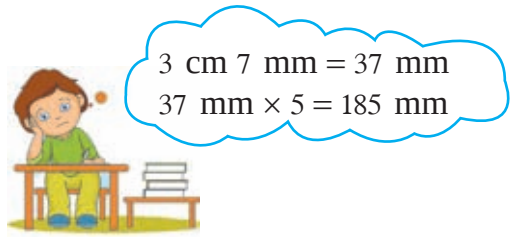
Method I

cm	mm
3	7
×	5
18	5

7 mm × 5 = 35 mm
35 mm = 3 cm 5 mm
Let us write 5 mm in the millimetres column.
3 cm × 5 = 15 cm
Let us add the 3 cm to the 15 cm.
3 cm + 15 cm = 18 cm
Let us write 18 cm in the centimetres column.

Method II

Let us express 3 cm 7 mm, in millimetres and then multiply by 5.



mm
37
× 5
185

185 mm = 18 cm 5 mm
3 cm 7 mm × 5 = 18 cm 5 mm

➢ Let us simplify 3 km 175 m × 12.

Method I

km	m
3	175
×	12
38	100

Let us first multiply 175 m by 12.

175 m × 12 = 2100 m

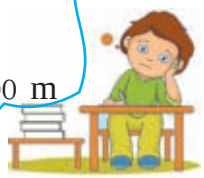
= 2 km 100 m

Now let us multiply 3 km by 12.

3 km × 12 = 36 km

3 km 175 m × 12 = 36 km + 2 km 100 m

= 38 km 100 m



Method II

Let us express 3 km 175 m, in metres and then multiply by 12.

3 km 175 m = 3175 m

3175 m × 12 = 38 100 m

38 100 m = 38 km 100 m

∴ 3 km 175 m × 12 = 38 km 100 m

3175
× 12
6350
3175
38100

Exercise 16.3

(1) Simplify.

(i) 5 cm 2 mm × 5 (ii) 12 cm 7 mm × 5 (iii) 5 m 25 cm × 7

(iv) 2 m 50 cm × 15 (v) 35 km 7 m × 6 (vi) 2 km 450 m × 16

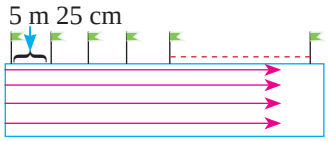
(2) Cloth of length 1 m 35 cm is required to sew a child's dress. Find the length of cloth required to sew 8 such dresses.

(3) Seven pieces of ribbon, each of length 12 cm 5 mm, are required to make a wall hanging. What is the minimum length of the ribbon needed to cut these seven pieces?

(4) In a play ground, the running tracks are straight as shown in the figure. Along the edge of the running track, flags are placed 5 m 25 cm apart as shown in the figure. There are 21 such flags.

(i) How many such 5 m 25 cm gaps are there along the row of flags?

(ii) Find the distance between the first and the 21st flag.



(5) Twelve tiles are stacked one on top of another. Each tile is of thickness 2 cm 4 mm. Find the height of the stack of tiles.

(6) To get to the second floor of a two storey house, it is necessary to climb 35 steps, each of height 15.75 cm.

(i) Find how many centimetres above the first floor, the second floor is located.

(ii) Express this height in metres.

• Division of a measurement of length by a whole number

Let us now study how to divide measurements of length by a whole number.

➢ Suppose we are given a wire of length 5 m 46 cm and cut it into 2 equal pieces. Let us find the length of one piece.

Here we need to divide the length of the wire by 2.

Method I

Let us express 5 m 46 cm in centimetres and then divide by 2.

5 m 46 cm = 546 cm

546 cm ÷ 2 = 273 cm

273 cm = 2 m 73 cm

$$\begin{array}{r|l} & 273\text{ cm} \\ 2 & 546\text{ cm} \\ & 4 \\ \hline & 14 \\ & 14 \\ \hline & 6 \\ & 6 \\ \hline & 0 \end{array}$$

So the length of one piece = 2 m 73 cm

Method II

$$\begin{array}{r|l} & 2\text{ m }\ 73\text{ cm} \\ 2 & 5\text{ m }\ 46\text{ cm} \\ & 4 \\ \hline & 1\text{ m} \rightarrow 100\text{ cm} \\ & 146\text{ cm} \\ & 146\text{ cm} \\ \hline & 00 \end{array}$$

Let us divide the 5 m in the metres column by 2.
Let us carry the remainder which is 1 m to the centimetres column.
Then the number in the centimetres column is
100 cm + 46 cm = 146 cm.
146 cm ÷ 2 = 73 cm

So the length of one piece = 2 m 73 cm.

Example 1

Simplify $65 \text{ cm } 7 \text{ mm} \div 9$.

Method I

Let us express 65 cm 7 mm, in millimetres and then divide by 9.

```
     73 mm
9 | 657 mm
    63
    27 mm
    27 mm
    00
```

$65 \text{ cm } 7 \text{ mm} = 657 \text{ mm}$

$65 \text{ cm } 7 \text{ mm} \div 9 = 73 \text{ mm}$

$= 7 \text{ cm } 3 \text{ mm}$

Method II

```
     7 cm 3 mm
9 | 65 cm 7 mm
    63
     2 --> 20 mm
           27 mm
           27 mm
           00
```

Let us divide the 65 cm in the centimetres column by 9. Let us take the remaining 2 cm, to the millimetres column as 20 mm and find the amount in the millimetres column.

$20 \text{ mm} + 7 \text{ mm} = 27 \text{ mm}$

$27 \text{ mm} \div 9 = 3 \text{ mm}$

$65 \text{ cm } 7 \text{ mm} \div 9 = 7 \text{ cm } 3 \text{ mm}$

Example 2

Simplify $8 \text{ km } 740 \text{ m} \div 5$.

Method I

Let us express 8 km 740 m in metres and then divide by 5.

```
     1748 m
5 | 8740 m
    5
    37
    35
     24
     20
      40
      40
      00
```

$8 \text{ km } 740 \text{ m} = 8740 \text{ m}$

$8740 \text{ m} \div 5 = 1748 \text{ m}$

$8 \text{ km } 740 \text{ m} \div 5 = 1748 \text{ m}$

$= 1 \text{ km } 748 \text{ m}$

Method II

```
     1 km     748 m
5 | 8 km     740 m
    5
    3 --> 3000 m
          3740
          35
           24
           20
            40
            40
            00
```

Let us divide the 8 km in the kilometres column by 5.

Let us take the remaining 3 km, to the metres column as 3000 m. Then the amount in the metres column is

$3000 \text{ m} + 740 \text{ m} = 3740 \text{ m}.$

$3740 \text{ m} \div 5 = 748 \text{ m}$

$8 \text{ km } 740 \text{ m} \div 5 = 1 \text{ km } 748 \text{ m}$

Exercise 16.4

(1) Fill in the blanks.

(i)
$$\begin{array}{r|l} 12 & \begin{array}{l}\text{.... cm .... mm} \\ \text{43 cm 2 mm} \\ \underline{36} \\ \text{.... } \rightarrow \underline{\text{....}} \\ \text{72 mm} \\ \underline{\text{....}} \\ \text{....}\end{array}\end{array}$$

(ii)
$$\begin{aligned} 43 \text{ cm } 2 \text{ mm} &= \text{..... mm} \\ 43 \text{ cm } 2 \text{ mm} \div 12 &= \text{..... mm} \div 12 \\ &= \text{..... mm} \\ &= \text{..... cm ..... mm} \end{aligned}$$

(2) Simplify the following.

(i) 15 cm 6 mm ÷ 3 (ii) 96 cm 6 mm ÷ 7 (iii) 12 m 48 cm ÷ 8

(iv) 205 m 70 cm ÷ 10 (v) 8 km 40 m ÷ 3 (vi) 2 km 750 m ÷ 5

(3) If a wire of length 8 m is cut into 20 equal parts, find the length of one part.

(4) A piece of cloth of length 35 m was used to sew 25 flags of equal size for a festival. If the entire piece of cloth was used to sew the flags, then find the length of the material used to sew one flag.

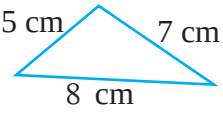
(5) A plot of land is of length 14 m. The figure shows how 6 concrete poles are placed along one side of the border of this plot of land. The gap between any two nearby poles is the same. Find the gap between two nearby poles.

(6) A quantity of 57.6 m of material was bought for costumes and distributed equally among 24 members of a band. Find the quantity of material one person received.

16.5 Perimeter

In grade 6 you learnt that the length around a closed plane figure is called its perimeter.

Let us find the perimeter of the triangle shown in the figure.



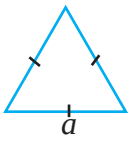
The sum of the lengths of all three sides of the triangle $= 8 \text{ cm} + 7 \text{ cm} + 5 \text{ cm}$

$= 20 \text{ cm}$

Therefore the perimeter of the triangle $= 20$ cm

- **Perimeter of an equilateral triangle**

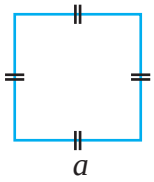
If the side length of an equilateral triangle is a units and the perimeter is p units, then



$$p = a + a + a$$
$$p = 3a$$

- **Perimeter of a square**

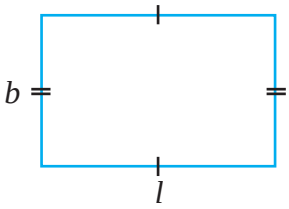
If the side length of a square is a units and the perimeter is p units, then



$$p = a + a + a + a$$
$$p = 4a$$

- **Perimeter of a rectangle**

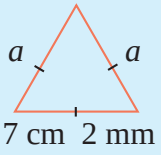
If in a rectangle, the length is l units, the width is b units and the perimeter is p units, then



$$p = l + b + l + b$$
$$p = 2l + 2b$$
or
$$p = 2\ (l + b)$$

Example 1

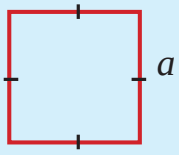
The length of an equilateral triangle is 7 cm 2 mm. Find its perimeter.



Perimeter of the triangle $= 3a$
$= 3 \times (7 \text{ cm } 2 \text{ mm})$
$= 21 \text{ cm } 6 \text{ mm}$

Example 2

The perimeter of a square is 25 cm 6 mm. Find the length of a side.



If the length of a side is a units, then

the perimeter of the square $= 4a = 25 \text{ cm } 6 \text{ mm}$

$\therefore$ the length of a side $= a = 25 \text{ cm } 6 \text{ mm} \div 4$

The length of a side is 6 cm 4 mm.

$$\begin{array}{r|l} & 6 \text{ cm } 4 \text{ mm} \\ \hline 4 & 25 \text{ cm } 6 \text{ mm} \\ & 24 \\ & \underline{1} \rightarrow \underline{10 \text{ mm}} \\ & 16 \text{ mm} \\ & \underline{16 \text{ mm}} \\ & 00 \end{array}$$

Example 3

The length of a rectangle is 3 cm greater than its width. If the width is 5 cm, then find the perimeter.

The length of the rectangle = width + 3 cm

$= 5 \text{ cm} + 3 \text{ cm} = 8 \text{ cm}$

l = length = width + 3 cm

$b = 5$ cm

The perimeter of the rectangle = $2l + 2b = 2 \times 8 + 2 \times 5$ cm

$= 16 + 10$ cm

$= 26$ cm

Exercise 16.5

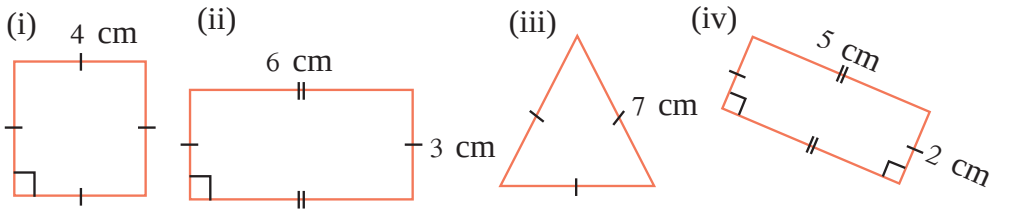
(1) Find the perimeter of each of the plane figures given below.

(i) 4 cm

(ii) 6 cm, 3 cm

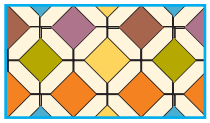
(iii) 7 cm

(iv) 5 cm, 2 cm

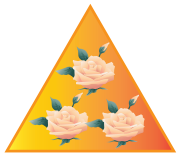


(2) (i) The figure denotes a square shaped stamp of side length 2.4 cm. Find the perimeter of the stamp.

(ii) Find the perimeter of the rectangular shaped tile of length 24 cm and breadth 5 cm shown in the figure.



(iii) The perimeter of an equilateral triangle shaped wall hanging is 48 cm 6 mm. Find the length of a side.



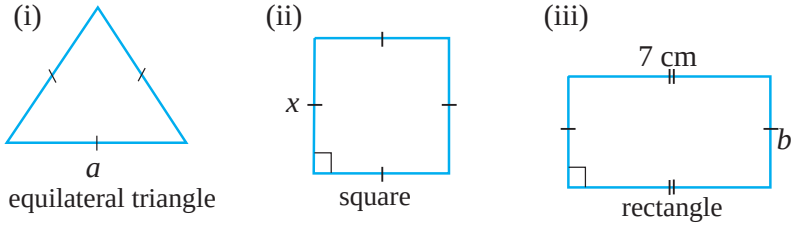
(iv) The perimeter of a square shaped handkerchief is 40 cm. Find the length of a side.

(3) The perimeter of each figure below is 24 cm. Find the values of a, x and b.

(i) a — equilateral triangle

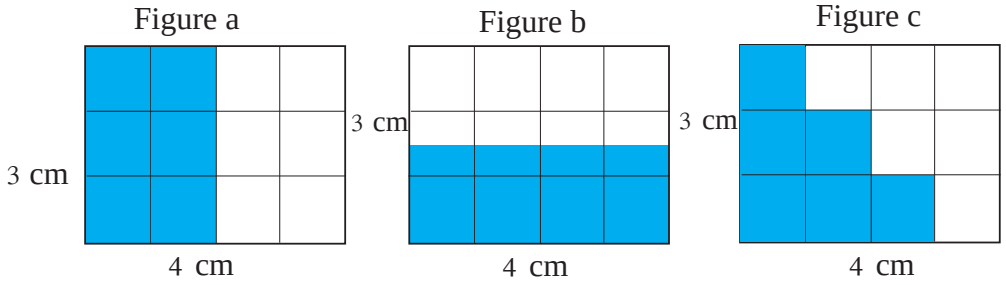
(ii) x — square

(iii) 7 cm, b — rectangle



(4) (i) Find the perimeter of a square shaped plot of land of side length 50 m.
(ii) Find the total length of five strands of wire needed to build a fence around the above plot of land.

(5) Three rectangular shaped laminas are shown in the following figure. Each of them are of length 4 cm and width 3 cm. One half of each of these laminas is shaded.



(i) Find the perimeter of a rectangle of length 4 cm and width 3 cm
(ii) Find the perimeter of the shaded region of Figure a.
(iii) Find the perimeter of the shaded region of Figure b.
(iv) Find the perimeter of the shaded region of Figure c.
(v) If a rectangular sheet of paper is divided into two equal parts, will the perimeter of one of these parts be equal to half the perimeter of the rectangle?

Summary

- 10 mm = 1 cm 100 cm = 1 m 1000 m = 1 km
- If a side of an equilateral triangle is a, then its perimeter is $3a$.
- If a side of a square is a, then its perimeter is $4a$.
- If the length a rectangle is l and its width is b, then its perimeter is $2l + 2b$. That is $2\ (l + b)$.

Ponder

There are four iron rods of length 85 cm, 1m 23 cm, 2 m 9 cm and 1 m 73 cm respectively. Find the length of the longest and the shortest rod that can be made by soldering three of these rods together. Assume that the lengths of the rods do not change when they are soldered together.