CHAPTER - 10

Perimeter and Area

10.1 Introduction

We studied about different shapes in chapter "Basic Geometrical Shapes". When we talk about plane figures, we think of regions covered by them and their boundaries. We need some measures to compare their sizes. Let us look into this now.

10.2 Perimeter

Think of the following situations:

1. A boy is running around a circular path. He starts running from point A and stops at A. Then the distance covered by the boy is the perimeter of the circular path.

2. A man wants to fence his field with wire. To find the length of wire needed he would have to measure the sides of the field.

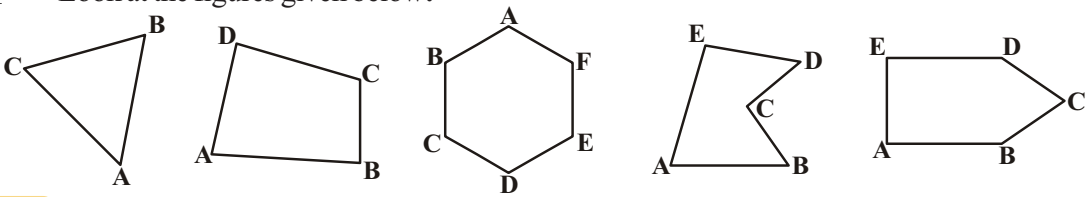
This will give the perimeter of the field. The length of the boundary of a closed figure is called its perimeter. We use perimeter in many situations of our daily life.

Try These

Give five examples of situations where you need to know the perimeter.

We can look at perimeter in another way.

Look at the figures given below:



Take a wire or a string. Break the string in to pieces of appropriate lengths, start placing the string pieces on the sides. When all the sides are covered, we can put the string together and measure its length. The length of the string is equal to the distance in going around the shape once.

This length is known as the perimeter of the closed figure. It is the length of the wire to form the figures.

We can say that perimeter is the distance covered along the boundary forming a closed figure when you go around the figure once.

Do This

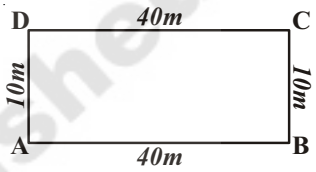
What would be the perimeter of these shape?

Fill in the blanks given and in each case start from the point A.

(i) Perimeter = AB + ... + ... +.....

= .....+..... + ... + ...

= ..... m



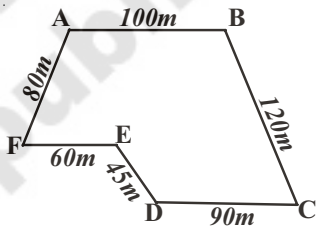
(ii) Perimeter = AB + ... + ...

+ ..... + ... + ...

= ..... + ... + ...

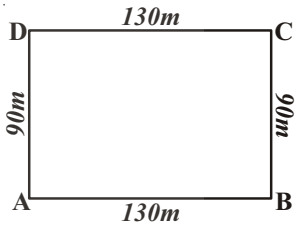
+ ..... + ... + ...

= ..... m



We see that to find the perimeter of a closed figure made up entirely of line segments we find the sum of the lengths of all the sides.

Example-1. Ritu went to a park 130m long and 90m wide. She took one complete round of it. What distance did she cover?



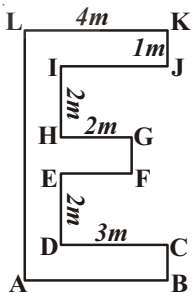
***Solution*:** Total distance covered by Ritu:

Perimeter of the park ABCD

= AB + BC + CD + DA

= 130 m + 90 m + 130 m + 90 m = 440 *m*

Example-2. Find the perimeter of given shape.



***Solution*:** IJ = DC = 3 m EF = HG = 2 m

AB = LK = 4 m FG = KJ = CB = 1 m

AL = BC + DE + FG + HI + JK

= 1 m + 2 m + 1 m + 2 m + 1 m

= 7 m

Perimeter = AB + BC + CD + DE + EF + FG + GH + HI + IJ + JK + KL + LA

= 4 m + 1 m + 3 m + 2 m + 2 m + 1 m

+ 2 m + 2 m + 3 m + 1 m + 4 m + 7 m = 32m

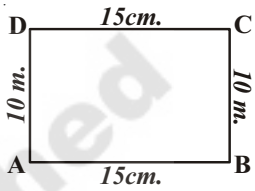
Try These

Find the perimeter of the following:

1. A table with sides equal to 30 cm, 15 cm, 30 cm and 15 cm respectively.
2. Measure the length of the sides of your text book cover. What is the perimeter?
3. Around a rectangular park of sides 100 meter and 70 meters a wire has to be put. The cost of the wire is ₹ 20 per meter. What is the total cost of the wire?

10.2.1 Perimeter of a Rectangle

Let us consider a rectangle ABCD whose length and breadth are 15 *cm* and 10 *cm* respectively. What will be its perimeter?



Perimeter of the rectangle = Sum of the lengths of its four sides

= AB + BC + CD + DA

= AB + BC + AB + BC

= 2 × AB + 2 × BC

= 2 × (AB + BC)

= 2 × (15 cm + 10 cm)

= 2 × 25 cm

= 50 cm

We know that the opposite sides of a rectangle are equal

so AB = CD, AD = BC

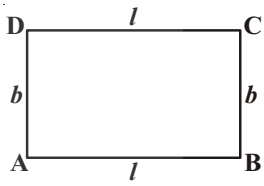
We see that

perimeter of a rectangle = length + breadth + length + breadth

i.e. perimeter of rectangle = 2 × (length + breadth)

Perimeter of rectangle **P = 2 (*l* + *b*)**

where *l* = length, *b* = breadth and p = perimeter.



Try These

Find the perimeter of the following rectangles.

Length of rectangle	Breadth of rectangle	Perimeter by adding all the sides	Perimeter by the formula 2 × (Length+Breadth)
20 cm	15 cm	= 20 cm + 15 cm + 20 cm + 15 cm = 70 cm	= 2×(20 + 15) = 2 × (35) = 70 cm
0.7 m	0.3 m		
22 cm	18 cm		
12.5 cm	7.5 cm		

Example-3. Find the perimeter of a rectangular field which is 36 m long and 24 m wide.

Solution: Length of the field $l = 36$ m

Breadth of the filed $b = 24$ m

Therefore, perimeter of the field $= 2(l + b)$

$= 2(36 + 24)$ m

$= 2 \times 60$ m

$= 120$ m

Example-4. Find the breadth of a rectangle whose perimeter is 76 cm and length is 26 cm

***Solution*:** Perimeter of the rectangle $P = 76$ cm

Length of the rectangle $l = 26$ cm

Perimeter of the rectangle $= 2$ (length + breadth)

so, $76 = 2(26 +$ breadth$)$

$26 +$ breadth $= 76 \div 2 = 38$

Breadth $= 38 - 26 = 12$ cm

Hence, breadth of the rectangle $= 12$ cm

Example-5. The length and breadth of a rectangular field are 22.5 *m* and 14.5 *m* respectively. Find the cost of fencing its four sides at the rate of ₹ 6 perimeter.

***Solution*:** Length of the field $l = 22.5$ m

Breadth of the field $b = 14.5$ m

Perimeter of the filed $(P) = 2(l + b)$

$= 2(22.5 + 14.5)$ m

$= 2 \times 37$ m

$= 74$ m

Thus, cost of fencing at ₹ 6 per meter.

$=$ ₹ (6×74)

$=$ ₹ 444

Example-6. How many different rectangles with integral measurements can be drawn with perimeter as 32 cm

***Solution*:** Half of the perimeter $= \frac{32}{2}$ cm $= 16$ cm

Now, we have to find the number of rectangles that can be drawn, the sum of whose length and breadth is 16 cm. Keeping in mind that the sides are positive integers in cm,

all possible pairs of length and breadth are

(15, 1) (14, 2) (13, 3) (12, 4) (11, 5) (10, 6) (9, 7) (8, 8)

Hence, eight rectangles can be drawn.

Do This

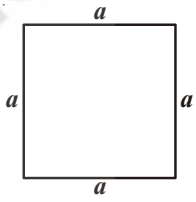
1. A square picture frame has sides of 0.75 meters. If the cost of a coloured paper is ₹ 20 per meter, what is the cost of putting coloured paper around the frame?
2. There is a string of length 44 cm. How many different rectangles with positive integers as length and breadth can be made with this string?
3. If I have a string 41 cm long can I make a rectangle using the string completely? Give reasons.

10.2.2 Perimeter of Regular shapes

Polygons are the simple closed plane figures bounded by line segments. A polygon is called a regular polygon, if all its sides are of equal length and all angles are of equal measure.

Equilateral triangle is a regular three sided polygon.

Square is a regular four sided polygon. Now let us try to find the perimeter of a square.



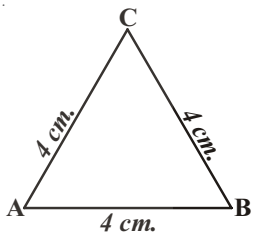
Since the sides of a square are equal.

So, perimeter is = a + a + a + a

$= 4 \times a = 4a$

Perimeter of a square = 4 × length of anyside.

Now, look at equilateral triangle with each side equal to 4 cm Can we find its perimeter?



Perimeter of this equilateral traingle

= (4 + 4 + 4) cm

= 3 × 4 cm = 12 cm

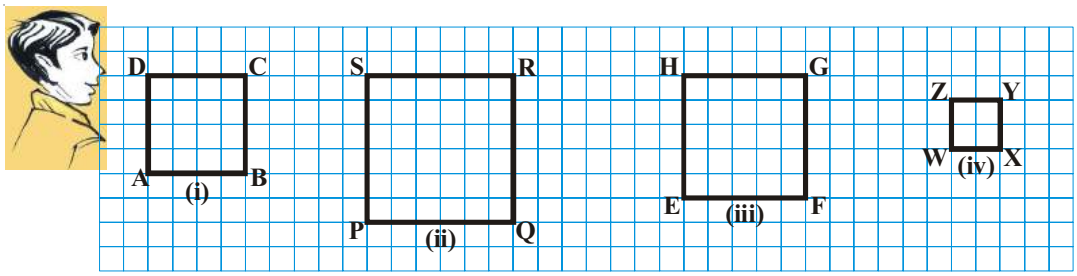
In general if 'a' represents the side of an equilateral triangle then the perimeter is $3 \times a = 3a$.

So, we find that

Perimeter of an equilateral triangle = 3 × length of any side

Try These

1. Find the perimeter of the following squares. Figures are drawn on 1 cm grids.



2. Find various objects from your surroundings which have regular shapes and their perimeters.

Regular Shapes

Geometrical shapes that have all the sides equal and all angles equal are called regular shapes. Square and equilateral triangles are examples of regular shapes. There can be 5-sided, 6-sided or more sided regular figures. Their perimeters are the sum of their sides.

We can thus see that in general
perimeter of a regular 5-sided polygon (pentagon) = 5 × length of any side
perimeter of a regular 6-sided polygon (Hexagon) = 6 × length of any side
perimeter of a regular 8-sided polygon (Octagon) = 8 × length of any side

Do This

Find the perimeter of a regular pentagon of side 8 *cm*

Example-7. Find the cost of fencing a square park of side 250 m at the rate of ₹ 20 per meter.

Solution: Perimeter of the square park = 4 × length of a side
= 4 × 250 m = 1000 m
Rate of fencing the park = ₹ 20 per meter
Thus, total cost of fencing the park = ₹ 1000 × 20 = ₹ 20,000

Example-8. Find the side of the equilateral triangle whose perimeter is 54 cm

Solution: Perimeter of an equilateral traingle = 3 × length of a side

Thus, length of a side $= \frac{\text{Perimeter}}{3} = \frac{54\ cm}{3} = 18$ cm

Example-9. A piece of wire is 24 cm. long. What will be the length of each side, if the wire is used to form.

(i) an equilateral triangle? (ii) a square? (iii) a regular hexagon?

Solution:

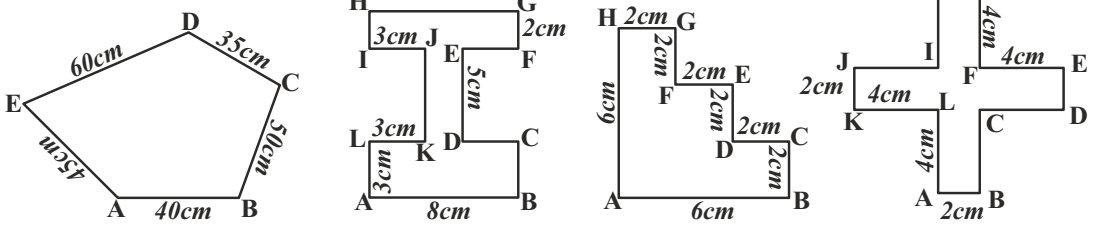
(i) An equilateral traingle has 3 equal sides, so we can divide the length of the wire by 3 to get the length of one side.
Each side of the equilateral triangle $= \frac{24\ cm}{3} = 8$ cm

(ii) A square has 4 equal sides, so we can divide the length of the wire by 4 to get the length of one side.
so each side = $\frac{24\ cm}{4} = 6$ cm

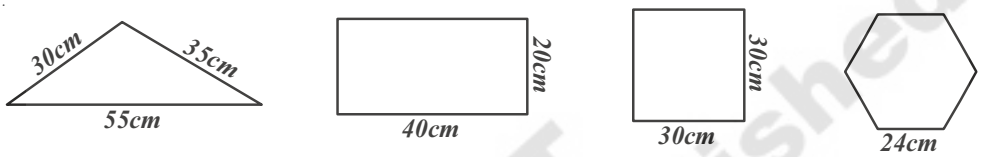
(iii) A regular hexagon has 6 equal sides, so we can divide the length of the wire by 6 to get the length of one side.
Each side of the hexagon = $\frac{24cm}{6} = 4$cm

EXERCISE - 10.1

1. Find the perimeter of each of the following shapes:



2. Find the perimeter of each of the following figures.



What would be cost of putting a wire around each of these shapes given that 1cm wire costs ₹ 15.

3. How many different rectangles can you make with a 24 cm long string with integral sides and what are the sides of those rectangles in cm?

4. A flower bed is in the shape of a square with a side 3.5 m Each side is to be fenced with 4 rows of ropes. Find the cost of rope required at ₹ 15 per meter.

5. A piece of wire is 60 cm long. What will be the length of each side if the string is used to form:
   (i) an equilateral triangle
   (ii) a square.
   (iii) a regular hexagon
   (iv) a regular pentagon.

6. Bunty and Bubly go for jogging every morning. Bunty goes around a square park of side 80m and Bubly goes around a rectangular park with length 90m and breadth 60m. If they both take 3 rounds, who covers greater distance and by how much?

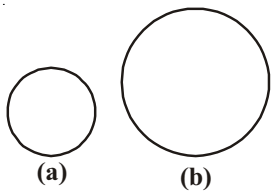
7. The length of a rectangle is twice of its breadth. If its perimeter is 48 cm, find the dimensions of the rectangle?

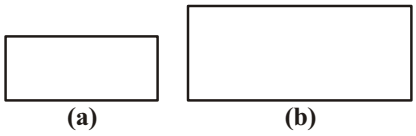
8. Two sides of a triangle are 12 cm and 14 cm. The perimeter of the triangle is 36 cm. What is the length of third side?

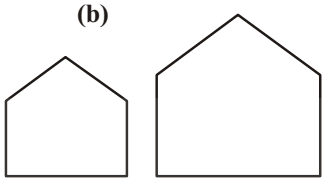
9. Find the perimeter of each of the following shapes:
   (i) A triangle of sides 3 cm, 4 cm and 5 cm
   (ii) An equilateral triangle of side 9 cm
   (iii) An isosceles triangle with equal sides 8 cm each and third side of 6 cm

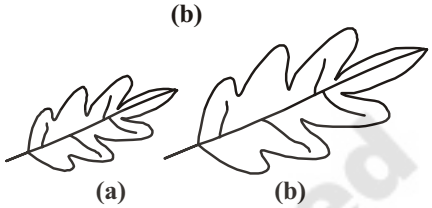
10.3 Area

Look at the closed figures given below. All of them occupy some region of a flat surface. Can you find which one occupies more region? Mark a tick (✓) on them:







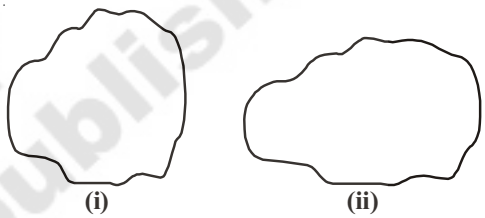


The amount of surface enclosed by a closed figure is called its area.

In the above pair of figures you can tell, which has more area but is that always possible?

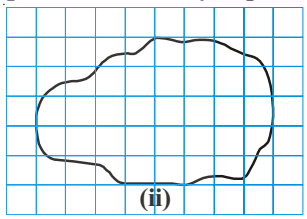
Now look at the adjecent figures.

Which has more area? It is not easy to say. Let us use a graph paper to help.

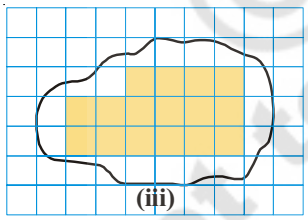


Take the shape (ii) and place it on a squared paper or graph paper where every square measures 1 cm × 1 cm

Make an out line of the figure. We have done one for you.



Look at the squares covered by the figure. Some of them are completely covered, some half, Some less than half and some more than half. The completely covered squares are shown shaded in picture (iii).



We know that the area is the number of centimeter squares that are needed to cover the shape.

But as we can see there is a small problem. The squares donot always fit exactly into the area you measure. Some fit completely, some are marginally covered and some are largely included in the shape. We get over this difficulty by adopting a convention.

- Ignore portions of the area that are less than half a square.
- If more than half of a square is in the region, just count it as one square.
- If exactly half the square is counted, take its area as ½ square unit.
- The area of one full square is taken as 1 square unit. If it is a centi meter square sheet, then the area of one full square will be a square centimeter.

Such a convention gives a fair estimate of the desired area as the ignored ones balance with the incomplete ones included.

Now count the squares in the figure (iii) and fill in the information in the table.

	Covered Area	No. of squares	Estimated Area (sq units)
(i)	Fully-filled squares	17	17
(ii)	Half-filled squares	3	3 × ½
(iii)	More than half-filled squares	4	4
(iv)	Less than half filled squares	5	0

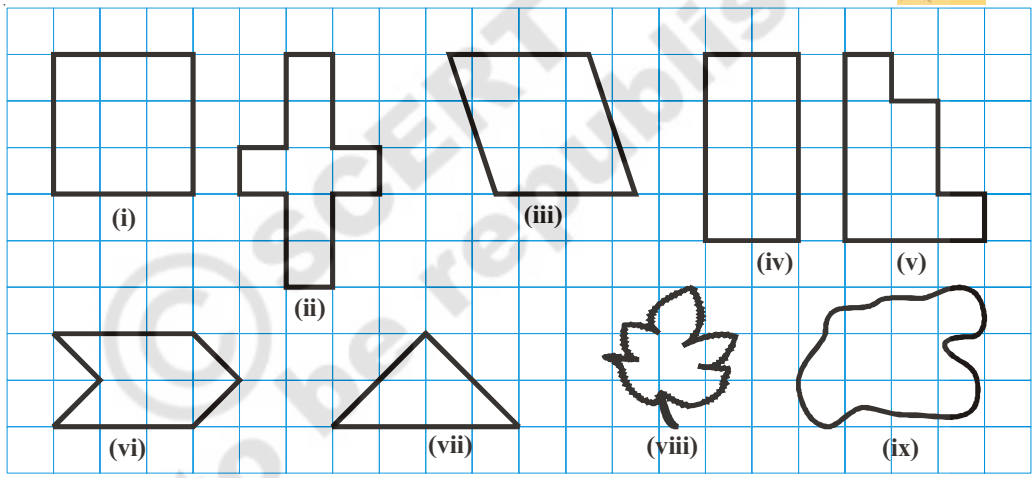
We can thus compare any two shapes by counting the squares covered by their outline on the graph or square paper grid.

Total area = 17 + 3 × ½ + 4

= 22½ sq units

Try This

Find the areas of the following figures by counting squares.

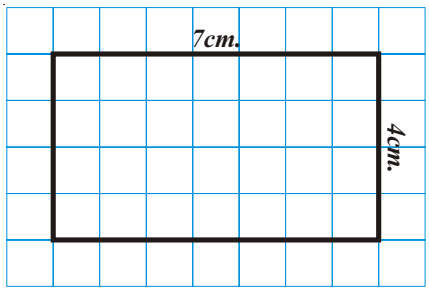


Do This

1. Trace shapes of leaves, flower petals and other such objects on the graph paper and find their area approximately.
2. Draw any line diagram on a graph sheet. Count the squares and use them to estimate the area of the region.

10.3.1 Area of the rectangle

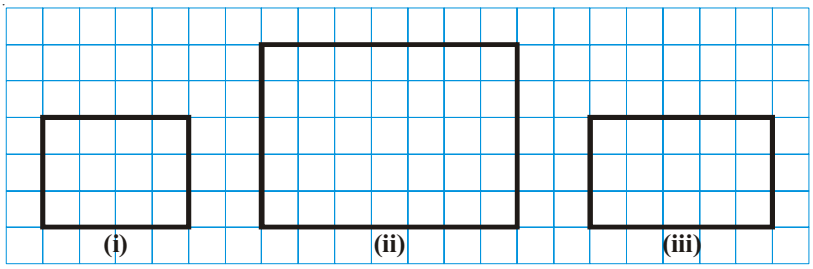
With the help of the squared paper, can we tell the area of a rectangle whose length is 7 cm and breadth is 4 cm.



Draw the rectangle on a graph paper having 1 cm × 1 cm squares. The rectangle covers 28 squares completely. ∴ The area of the rectangle = 28 sq cm

We can see that there are 7 squares in each row and there are 4 rows.

This can be written as 7 × 4 sq cm i.e. (Length × breadth) = 28 sq cm



2.

S.No.	Length	Breadth	Area (Total no. of squares)	length × breadth
1.	04	03	12	4 × 3 =12 sq cm
3.				

Thus from the above discussion and the results we can establish that

Area of rectangle = length × breadth

Without using the graph paper, we can now able to find the area of a rectangle. For example if the length of a rectangle is 6 cm and breadth is 4 cm then the

Area of the rectangle = Length × breadth

= 6cm × 4cm

= 24 sq cm

TRY THESE

1. Draw two different rectangles having the same perimeter. Compare their areas. Are they same? Can you draw two different squares having the same perimeter.

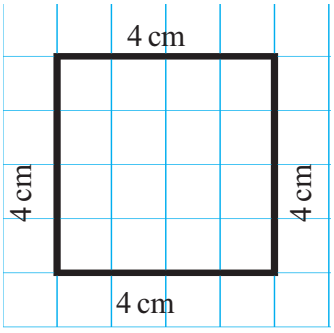
DO THIS

1. Find the area of:

(i) The floor of your classroom. (ii) A door in your house

(iii) The black board in your classroom.

10.3.2 Area of the Square



Let us consider a square of side 4 cm

If we place it on a centimeter graph paper then what do we observe?

It covers 16 squares i.e.

the area of the square = 4 × 4 sq cm = 16 sq cm

There are four squares in each row and there are four rows.

So the area is 4 × 4 sq cm. We know that a square is just like a rectangle with the special condition that its length is equal to the breadth.

TRY THESE

The length of one side of few squares are given. Find their areas using graph papers.

(i) 4 cm (ii) 6 cm (iii) 2 cm (iv) 8 cm

Compare the results with finding the area using the rule.

Area of the square = **Side × Side**

= (Side)²

The results will match.

Example-10. How many tiles with dimensions 12 cm and 5 cm will be needed to fit a region whose length and breadth are 144 cm and 100 cm respectively.

Solution: Length of the region = 144 cm

Breadth of the region = 100 cm

Area of the region = 144 cm × 100 cm

= 14,400 sq cm

Length of 1 tile = 12 cm

Breadth of 1 tile = 5 cm

Area of 1 tile = 12 cm × 5 cm

= 60 sq cm

$\therefore$ Number of tiles required $= \frac{\text{area of region}}{\text{area of 1 tile}} = \frac{14400}{60}$

= 240 tiles

Example-11. The perimeters of a rectangle and a square are same. If the length and breadth of the rectangle are 35 cm and 25 cm respectively, find which figure has greater area and by how much.

Solution: Perimeter of the rectangle = 2 (length + breadth)

= 2 (35 + 25) = 2 × 60 = 120 cm

$\therefore$ So perimeter of the square = 120 cm

Now side of the square $= \frac{120}{4} = 30$ cm

$\therefore$ Area of the square = (side)² = (30)² = 900 sq cm

Area of the rectangle = length × breadth

= 35 × 25 = 875 sq cm

Thus the square has greater area by (900 - 875) sq cm = 25 sq cm

Example-12. Find the area of a rectangle whose length is 4 m. and breadth 68 cm Calculate the area in sq cm

Solution: Breadth of the rectangle = 68 cm

Length of the rectangle = 4m = 400 cm

Area of the rectangle = length × breadth

= 400 × 68 sq cm

= 27, 200 sq cm

***Example*-13.** The area of a rectangular garden which is 40 meter long is 1120 sq m Find the width of the garden?

Solution: Area of the rectangle = 1,120 square meters

Length of the rectangle = 40 meters

Area of the rectangle = length × width

So width $= \frac{\text{Area}}{\text{Length}} = \frac{1120}{40} = 28$ meters

***Example*-14.** Five square flower beds each of side 1m are dug on a piece of land 5m long and 4 m wide. What is the area of the remaining part of the land?

Solution: Area of the piece of land = length × breadth

= 5 × 4 sq meters

= 20 sq meters

Area of each square flower bed = 1 sq meters

So area of 5 square flower beds = 5 sq meters

Land remaining = 20 - 5 = 15 sq meters

EXERCISE - 10.2

1. Find the area of the rectangles with the given sides:
   (i) 50 cm and 20 cm
   (ii) 65 m and 45 m
   (iii) 25 cm and 16 cm
   (iv) 7 km and 19 km

2. Find the area of squares with the given sides:
   (i) 26 m (ii) 17 km
   (iii) 52 cm (iv) 8 cm

3. The area of rectangular frame is 1,125 sq cm. If its width is 25 cm, what is its length?

4. The length of a rectangular field is 60 m and the breadth is half of its length. Find the area of the field.

5. A square sheet of paper has a perimeter of 40 cm. What is the length of its side? Also find the area of the square sheet?

6. The area of rectangular plot is 2400 square meters and the sides are in the ratio 3:2. What is the perimeter?

7. The length and breadth of a room are 6 m and 4 m respectively. How many square meters of carpet is required to completely cover the floor of the room? If the carpet costs ₹240 a square meter, what will be the total cost of completely covering the floor?

8. Two fields have the same perimeter. One is a square of side 72m and another is a rectangle of length 80 m. Which plot has the greater area and by how much?

9. The area of a square is 49 sq cm A rectangle has the same perimeter as the square. If the length of the rectangle is 9.3 cm, what is its breadth? Also find which has greater area?

10. Rahul owns a rectangular field of length 400 m and breadth 200 m. His friend Ramu owns a square field of length 300 m. Find the cost of fencing the two fields at ₹150 per meter. If one tree can be planted in an area of 10 sq m. who can plant more trees in his field? How many more trees can he plant?

11. The length of a rectangular floor is 20 m, more than its breadth. If the perimeter of the floor is 280 m, what is its length?

12. A rectangular plot of land is 240 m by 200 m The cost of fencing per meter is ₹30. What is the cost of fencing the entire field?

13. The side of a square field is 120 meters. The cost of preparing a grass lawn is ₹35 per square meter. How much will it cost, if the entire field is converted into a lawn?

14. What will happen to the area of rectangle, if

    (i) Its length and breadth are doubled?

    (ii) Its length is doubled and breadth is tripled?

15. What will happen to the area of a square if its side is:

    (i) doubled (ii) halved

WHAT HAVE WE DISCUSSED?

1. Perimeter is the distance covered along the boundary forming a closed figure when you go round the figure once.

2. (i) Perimeter of a rectangle = 2 × (length + breadth)
   (ii) Perimeter of a square = 4 × length of its side
   (iii) Perimeter of an equilateral triangle = 3 × length of any side

3. (i) Figures in which all sides and angles are equal are called regular closed figures.
   (ii) The perimeter of a regular figure is equal to the number of sides times the size of each side.

4. The amount of surface enclosed by a closed figure is called its area.

5. To calculate the area of a figure using a squared paper, the following conventions are adopted:
   (i) Ignore portions of the area that are less than half a square.
   (ii) If more than half a square is in the region. count it as one square.
   (iii) If exactly half the square is covered, take its area as $\frac{1}{2}$ sq units.

6. (i) Area of a rectangle = length × breadth
   (ii) Area of square = side × side
   (iii) The area of a square is more than the area of any other rectangle having the same perimeter.