11 Mensuration

In this chapter, you will learn:

- Perimeter of a closed plane figure
- Perimeter of a closed plane figure made up entirely of line segments
- Perimeter of a rectangle
- Perimeter of regular plane figures
- Area of a closed plane figure
- Area of a rectangle and a square.

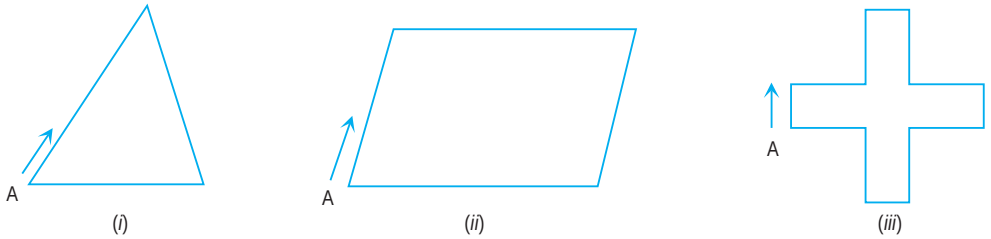
PERIMETER OF PLANE FIGURES

*The **perimeter** of a closed plane figure is the length of its boundary.*

The unit of measurement of perimeter is the same at that of length.

Perimeter of a closed plane figure made up entirely of line segments

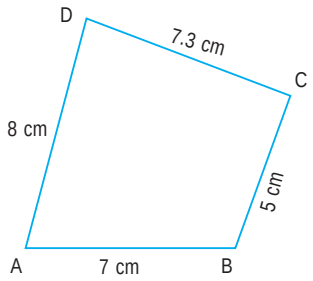
Look at the following figures. If you start from the point A in each case and move along the line segments then you again reach the point A. You have made one complete round of the shape in each case (*i*), (*ii*) and (*iii*). The distance covered is the length of the boundary.



(*i*) (*ii*) (*iii*)

Thus, perimeter is the distance covered along the boundary forming a closed plane figure when you go round the figure once.

Example 1. Find the perimeter of the adjoining quadrilateral.



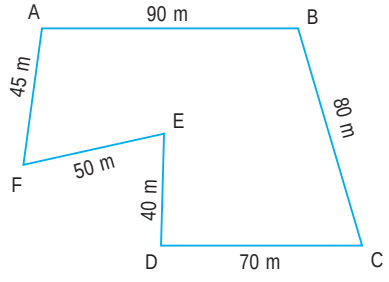
Solution. Perimeter of the given quadrilateral

$= AB + BC + CD + DA$

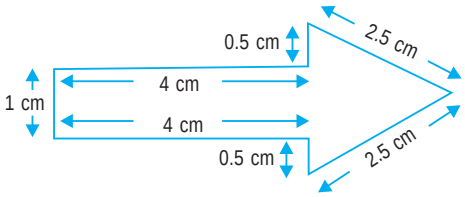
$= 7 \text{ cm} + 5 \text{ cm} + 7.3 \text{ cm} + 8 \text{ cm}$

$= 27.3 \text{ cm}.$

Example 2. Find the perimeter of the following figures:



(*i*)



(*ii*)

Solution.

(*i*) Perimeter of the given figure

= AB + BC + CD + DE + EF + FA

= 90 m + 80 m + 70 m + 40 m + 50 m + 45 m

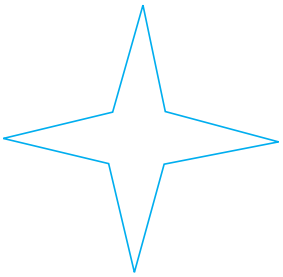
= 375 m.

(*ii*) Perimeter of the given figure

= 4 cm + 1 cm + 4 cm + 0.5 cm + 2.5 cm + 2.5 cm + 0.5 cm

= 15 cm.

Example 3. In the adjoining figure, the length of each side of an octagon is 2.25 cm, find the perimeter of the octagon.



Solution. As the length of each side of the given octagon is 2.25 cm, its perimeter = (8 × 2.25) cm

$= \left(8 \times \frac{225}{100}\right)$ cm $= \left(8 \times \frac{9}{4}\right)$ cm

= 18 cm.

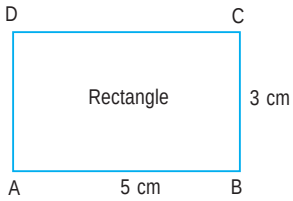
Perimeter of a rectangle

In the adjoining figure, ABCD is a rectangle.

As the lengths of the opposite sides of a rectangle are equal,

AB = DC = 5 cm

and BC = AD = 3 cm.



∴ Perimeter of the rectangle ABCD

= AB + BC + DC + AD

= 5 cm + 3 cm + 5 cm + 3 cm = 16 cm.

Notice that the perimeter of the rectangle ABCD

= AB + BC + DC + AD

= AB + BC + AB + BC

= 2 (AB + BC) = 2 (length + breadth).

Remember that opposite sides of a rectangle are equal

Perimeter of a rectangle = 2(length + breadth).

Thus, length of a rectangle = $\frac{1}{2}$ perimeter – breadth

and breadth of a rectangle = $\frac{1}{2}$ perimeter – length.

Perimeter of regular plane figures

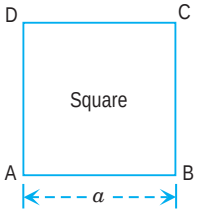
A simple closed curve made up entirely of line segments is called a **regular polygon** if all its sides are equal in length and all its angles are equal in measure.

All squares and all equilateral triangles are regular figures.

Perimeter of a square

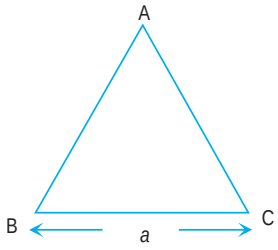
In a square, the lengths of all its four sides are equal. So,

Perimeter of a square = 4 × length of a side.



Perimeter of an equilateral triangle

In an equilateral triangle, the lengths of all its sides are equal. So,



Perimeter of an equilateral triangle = 3 × length of a side.

Thus, P = 3a, where P = perimeter and a = length of a side of the equilateral triangle.

Perimeter of a regular pentagon

In a regular pentagon, the lengths of all its five sides are equal. So,

Perimeter of a regular pentagon = 5 × length of a side.

Perimeter of a regular hexagon

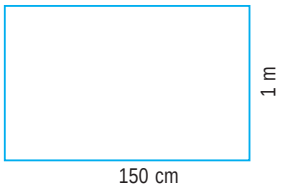
In a regular hexagon, the lengths of its six sides are equal. So,

Perimeter of a regular hexagon = 6 × length of a side.

Example 4. Find the perimeter of a rectangle whose length and breadth are 150 cm and 1 m respectively.

Solution. Length of the rectangle = 150 cm,

breadth of rectangle = 1m = 100 cm.



Perimeter of the rectangle = 2(length + breadth)

= 2(150 cm + 100 cm)

= (2 × 250) cm

= 500 cm

= 5 m.

Example 5. An athlete takes 10 rounds of a rectangular park, 70 m long and 40 m wide. Find the total distance covered by him.

Solution. Length of the rectangular park = 70 m,

breadth of rectangular park = 40 m.

The distance covered by the athlete in one round of rectangular park

= perimeter of the rectangular park

= 2(length + breadth) = 2(70 m + 40 m)

= (2 × 110) m = 220 m.

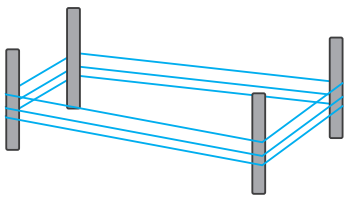
Total distance covered by the athlete

= distance covered by him in 10 rounds

= (10 × 220) m = 2200 m

= 2.2 km.

Example 6. A farmer has a rectangular field of length 240 m and breadth 150 m respectively. He wants to fence it with 3 rounds of rope as shown in the adjoining figure. If the rope costs ₹4 per metre, then find the cost of fencing the field.



Solution. Perimeter of the rectangular field = 2(length + breadth)

= 2(240 m + 150 m)

= (2 × 390) m = 780 m.

Since the farmer wants to fence the field with 3 rounds of rope, length of rope is three times the perimeter of the field.

$\therefore$ Length of rope required $= (3 \times 780)\,\text{m} = 2340$ m.

$\therefore$ The total cost of the rope = ₹ (2340×4)

= ₹ 9360.

Hence, the cost of fencing the field = ₹ 9360.

Example 7. Find the distance travelled by Ashu if he takes 7 rounds of a square park of side 90 m.

Solution. Perimeter of the square park = 4 × length of a side

$= (4 \times 90)$ m = 360 m.

Distance covered by Ashu in one round of park = 360 m.

$\therefore$ Total distance covered by Ashu in 7 rounds of park

$= (7 \times 360)$ m = 2520 m = 2.52 km.

Example 8. Pinky runs around a square field of side 85 m, Bob runs around a rectangular field of length 130 m and breadth 72 m. Who covers more distance and by how much?

Solution. Distance covered by Pinky in one round = perimeter of square field

= 4 × length of a side of the square

$= (4 \times 85)$ m = 340 m.

Distance covered by Bob in one round = perimeter of the rectangular field

= 2(length + breadth) = 2(130 m + 72 m)

$= (2 \times 202)$ m = 404 m.

$\therefore$ Difference in distance covered = 404 m – 340 m = 64 m.

Hence, Bob covers more distance by 64 m.

Example 9. If the perimeter of a regular hexagon is 21cm, find the length of its one side.

Solution. Given perimeter of the hexagon = 21 cm.

As a regular hexagon has 6 sides of equal length,

$\therefore$ perimeter of hexagon = 6 × length of a side

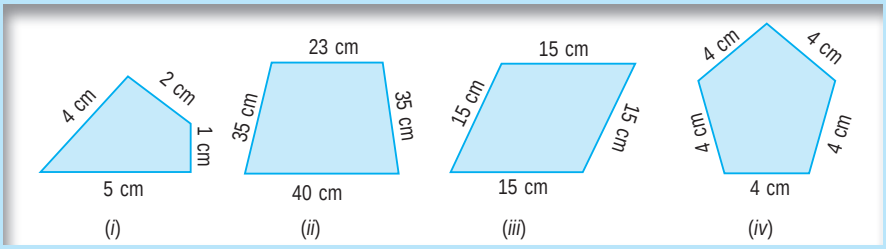
$\Rightarrow$ 21cm = 6 × length of a side

$\Rightarrow$ length of a side $= \frac{21}{6}$ cm $= \frac{7}{2}$ cm $= \left(\frac{7}{2} \times \frac{5}{5}\right)$ cm

$= \frac{35}{10}$ cm = 3.5 cm.

EXERCISE 11.1

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



2. 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 6 cm.

3. Find the perimeter of a triangle whose sides are 7 cm, 5.4 cm and 10.2 cm long.

4. The lid of a rectangular box of sides 40 cm by 10 cm is sealed all round with tape. What is the length of the tape required?

5. A table-top measures 2 m 25 cm by 1 m 50 cm. What is the perimeter of the table-top?

6. What is the length of the wooden strip required to frame a photograph of length and breadth 32 cm and 21 cm respectively?

7. A rectangular piece of land measures 0.7 km by 0.5 km. Each side is to be fenced with 4 rows of wires. What is the length of the wire needed?

8. Find the perimeter of a regular hexagon with each side measuring 8 m.

9. The lengths of two sides of a triangle are 12 cm and 14 cm. The perimeter of the triangle is 36 cm. What is the length of its third side?

10. Find the side of the square whose perimeter is 20 m.

11. The perimeter of a regular pentagon is 100 cm. How long is its each side?

12. A piece of string is 30 cm long. What will be the length of each side if the string is used to form:
   (*i*) a square? (*ii*) an equilateral triangle?
   (*iii*) a regular hexagon?

13. Find the cost of fencing a square park of side 250 m at the rate of ₹ 20 per metre.

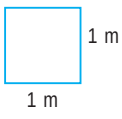
14. Find the cost of fencing a rectangular park of length 175 m and breadth 125 m at the rate of ₹ 12 per metre.

15. Meera went to a rectangular park 140 m long and 90 m wide. She took 5 complete rounds on its boundary. What is the distance covered by her?

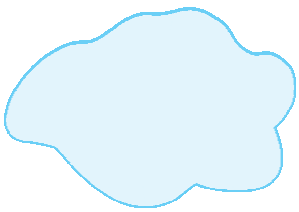
16. Pinky runs around a rectangular park with length 80 m and breadth 55 m while Pankaj runs around a square park of side 75 m. Who covers more distance and by how much?

AREA OF PLANE FIGURES

*The **area** of a closed plane figure is the measurement of the region (surface) enclosed by its boundary.*



To measure the area of a closed plane figure, we have to compare it with some unit of area. For convenience, the shape we choose for the unit of area is a unit square. If the side of the square is 1 metre, then the unit is called a ***square metre*** and if the side of the square is 1 cm, then the unit is called a ***square centimetre*** etc.



Look at the adjoining closed plane figure. To find the area of the region enclosed by the given figure, we place the figure on a squared paper where every square measures 1 unit × 1 unit.

Mark an outline of the figure. Look at the squares enclosed by the figure. The area is the number of unit squares that are covered by the figure.

But there may be a small problem – the unit squares may not fit exactly into the area that we need. However, we can overcome this problem by adopting a convention.