

# UNIT – 5 MENSURATION

## CHAPTER 23

# PERIMETER AND AREA OF PLANE FIGURES

### 23.1 INTRODUCTION

In mensuration, we deal with measurements of length, area, volume, surface area, etc. Knowledge of mensuration is of great use in our day-to-day life, specially, for instance, when we buy :

- (i) **cloth** for shirts by **length**, (ii) **a plot of land** by **area**  
 (iii) **milk, petrol**, etc., by **volume** and so on.

### 23.2 SOME DEFINITIONS

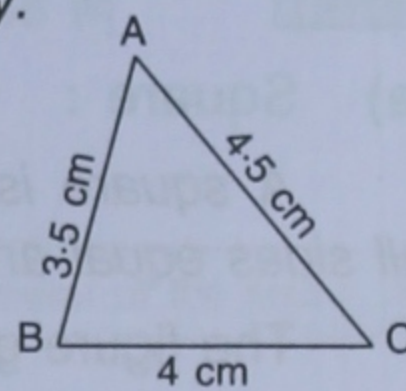
#### (a) (i) Perimeter :

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

*For example :*

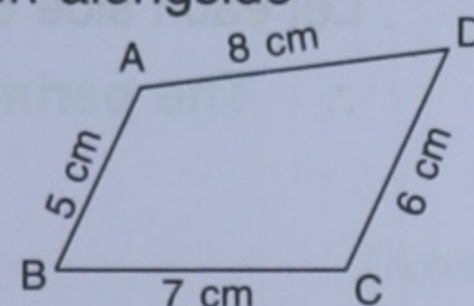
#### 1. Perimeter of $\triangle ABC$ given alongside

$$\begin{aligned} &= \text{Length of the boundary of } \triangle ABC \\ &= \text{Length of } AB + \text{length of } BC + \text{length of } CA \\ &= 3.5 \text{ cm} + 4 \text{ cm} + 4.5 \text{ cm} = \mathbf{12 \text{ cm}} \end{aligned}$$



#### 2. Perimeter of the plane figure (quadrilateral) ABCD given alongside

$$\begin{aligned} &= AB + BC + CD + DA \\ &= 5 \text{ cm} + 7 \text{ cm} + 6 \text{ cm} + 8 \text{ cm} = \mathbf{26 \text{ cm}} \end{aligned}$$



#### (ii) Unit of Perimeter :

*The unit of perimeter is the same as the unit of length, i.e. centimetre (cm), metre (m), etc.*

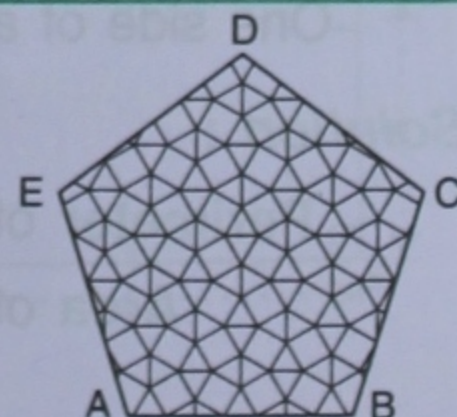
$$1. \quad 1 \text{ cm} = \frac{1}{100} \text{ m} \quad \text{and} \quad 1 \text{ m} = 100 \text{ cm}$$

2. For finding the perimeter of any plane-figure convert each length into the same unit, e.g. if the lengths of the sides of a triangular figure are 80 cm, 1.2 m and 95 cm, its **perimeter** = 80 cm + 1.2 m + 95 cm  
 = 80 cm + 120 cm + 95 cm 1.2 m = 1.2 × 100 cm = 120 cm  
 = **295 cm**

$$\begin{aligned} \text{OR, perimeter of the given triangle} &= 80 \text{ cm} + 1.2 \text{ m} + 95 \text{ cm} \\ &= 0.8 \text{ m} + 1.2 \text{ m} + 0.95 \text{ m} = \mathbf{2.95 \text{ m}} \end{aligned}$$

#### (b) (i) Area :

*The area of a plane figure is the measure of the size of the surface enclosed by its boundary.*



For example :

The area of the given figure ABCDE is the measure of the size of shaded portion that is enclosed by its boundary.

(ii) **Unit of Area :**

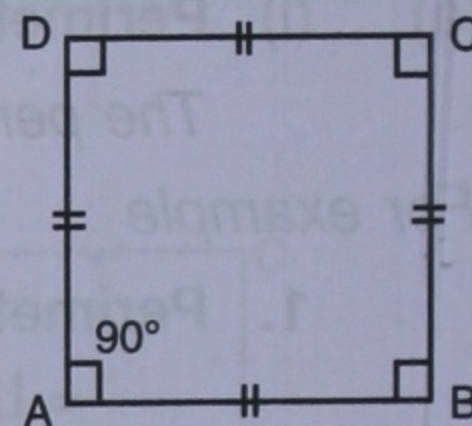
If the unit of the **length** of each side of a plane figure is **centimetre** (cm), the unit of its area will be **square-centimetre** (sq. cm, *i.e.*  $\text{cm}^2$ ). In the same way, if the **length** of each side of a plane figure is **metre** (m), the unit of its **area** will be **square-metre** (sq. m, *i.e.*  $\text{m}^2$ ).

$1 \text{ m} = 100 \text{ cm}$ and $1 \text{ m}^2 = 100 \times 100 \text{ cm}^2$ $= 10,000 \text{ cm}^2$ $1 \text{ cm} = \frac{1}{100} \text{ m}$ and $1 \text{ cm}^2 = \frac{1}{100} \times \frac{1}{100} \text{ m}^2$ $= \frac{1}{10,000} \text{ m}^2$	<b>Some other units in use :</b>	
	For length	For area
	1. Millimetre (mm)	Square millimetre ( $\text{mm}^2$ )
	2. Kilometre (km)	Square kilometre ( $\text{km}^2$ )

### 23.3 SOME IMPORTANT PLANE FIGURES

(a) **Square :**

A square is a four-sided closed figure with all sides equal and each angle  $90^\circ$ .



The figure given alongside shows a square ABCD in which  $AB = BC = CD = DA$   
 And  $\angle A = \angle B = \angle C = \angle D = 90^\circ$ .

Let each side of the square be of length  $a$  units, *i.e.*  $AB = BC = CD = DA = a$  units.

$$\begin{aligned} \therefore \text{The perimeter of the square} &= AB + BC + CD + DA \\ &= a + a + a + a \\ &= 4a = 4 \times \text{side of the square} \end{aligned}$$

$$\begin{aligned} \text{and area of the square} &= \text{its length} \times \text{its breadth} \\ &= a \times a = a^2 = (\text{side})^2. \end{aligned}$$

1. Since the perimeter ( $P$ ) of a square is given by the formula :

$$P = 4 \times \text{length of its side}$$

$$\therefore \text{Length of each side of the square} = \frac{\text{Its perimeter}}{4}$$

2. Since the area  $A$  of a square =  $(\text{side})^2$

$$\therefore \text{Length of its each side} = \sqrt{A}$$

**Example 1 :**

One side of a square is 6 cm. Find its perimeter and area.

**Solution :**

$$\text{Perimeter of the square} = 4 \times \text{side} = 4 \times 6 \text{ cm} = 24 \text{ cm} \quad (\text{Ans.})$$

$$\text{Area of the square} = (\text{side})^2 = (6 \text{ cm})^2 = 36 \text{ cm}^2 \quad (\text{Ans.})$$

**Example 2 :**

The perimeter of a square field is 96 m.

Find : (i) the length of its each side, (ii) the area of the square field.

**Solution :**

$$(i) \text{ Length of each side of the square} = \frac{\text{its perimeter}}{4} = \frac{96}{4} \text{ m} = 24 \text{ m} \quad (\text{Ans.})$$

$$(ii) \text{ Area of the square field} = (\text{side})^2 = (24 \text{ m})^2 = 576 \text{ m}^2 \quad (\text{Ans.})$$

**Example 3 :**

The area of a square is  $144 \text{ m}^2$ .

Find : (i) its side (ii) its perimeter.

**Solution :**

$$(i) \text{ Side of the square} = \sqrt{A} = \sqrt{144} \text{ m} \\ = \sqrt{2 \times 2 \times 2 \times 2 \times 3 \times 3} \text{ m} \\ = 2 \times 2 \times 3 \text{ m} = 12 \text{ m} \quad (\text{Ans.})$$

$$(ii) \text{ Perimeter of the square} = 4 \times \text{side} = 4 \times 12 \text{ m} = 48 \text{ m} \quad (\text{Ans.})$$

**Example 4 :**

Each side of a square field is 36 m. Find :

- (i) its perimeter  
 (ii) its area  
 (iii) the cost of fencing the field at the rate of ₹ 20 per metre.  
 (iv) the cost of ploughing the field at the rate of ₹ 1.50 per  $\text{m}^2$ .

Length of fencing = Perimeter of the field.

**Solution :**

$$(i) \text{ Perimeter of the square field} = 4 \times \text{its side} \\ = 4 \times 36 \text{ m} = 144 \text{ m} \quad (\text{Ans.})$$

$$(ii) \text{ Area of the square field} = (\text{side})^2 \\ = (36 \text{ m})^2 = 1,296 \text{ m}^2 \quad (\text{Ans.})$$

$$(iii) \text{ Cost of fencing the field} = \text{Rate of fencing} \times \text{perimeter} \\ = ₹ 20 \times 144 = ₹ 2,880 \quad (\text{Ans.})$$

$$(iv) \text{ Cost of ploughing the field} = \text{Rate of ploughing} \times \text{area} \\ = ₹ 1.50 \times 1296 = ₹ 1,944 \quad (\text{Ans.})$$

**(b) Rectangle :**

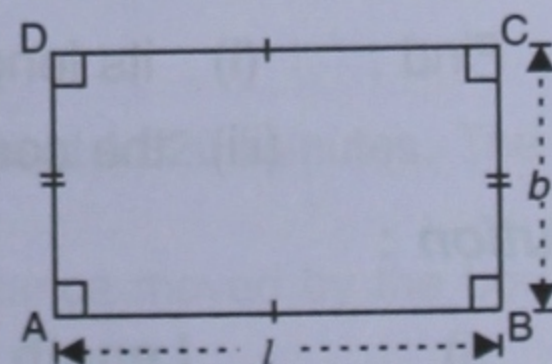
A rectangle is a four-sided closed figure of which the opposite sides are equal and each angle is  $90^\circ$ .

The adjacent figure shows a rectangle ABCD.

Clearly,  $AB = CD = \text{length } (l)$  of the rectangle

and,  $AD = BC = \text{breadth } (b)$  of the rectangle.

Also,  $\angle A = \angle B = \angle C = \angle D = 90^\circ$ .



$$\begin{aligned} \therefore \text{Perimeter of rectangle ABCD} &= \text{Length of its boundary} \\ &= AB + BC + CD + DA \\ &= l + b + l + b \\ &= 2(l + b) \quad \text{i.e. } P = 2(l + b) \end{aligned}$$

Opposite sides of a rectangle are equal

$$\begin{aligned} \text{And area of rectangle} &= \text{its length} \times \text{its breadth} \\ &= l \times b \quad \text{i.e. } A = l \times b \end{aligned}$$

### Example 5 :

The length and the breadth of a rectangle are 10 cm and 8 cm, respectively. Find its perimeter and area.

### Solution :

Since the length of the rectangle ( $l$ ) = 10 cm

and the breadth of the rectangle ( $b$ ) = 8 cm

$$\begin{aligned} \therefore \text{Perimeter (P)} &= 2(l + b) \\ &= 2(10 + 8) \text{ cm} = 36 \text{ cm} \quad \text{(Ans.)} \end{aligned}$$

$$\begin{aligned} \text{Area of rectangle (A)} &= l \times b \\ &= 10 \text{ cm} \times 8 \text{ cm} = 80 \text{ cm}^2 \quad \text{(Ans.)} \end{aligned}$$

1. Since the perimeter of a rectangle is given by the formula  $P = 2(l + b)$

$$\therefore \text{Its length, } l = \frac{P}{2} - b \text{ and its breadth, } b = \frac{P}{2} - l$$

2. Since the area of a rectangle is given by  $A = l \times b$

$$\therefore \text{Its length, } l = \frac{A}{b} \text{ and its breadth, } b = \frac{A}{l}$$

### Example 6 :

The perimeter of a rectangle is 30 cm and its length is 8 cm.

Find : (i) its breadth (ii) its area

### Solution :

Given :  $P = 30$  cm and  $l = 8$  cm

$$\therefore \text{(i) Breadth, } b = \frac{P}{2} - l = \frac{30}{2} \text{ cm} - 8 \text{ cm} = (15 - 8) \text{ cm} = 7 \text{ cm} \quad \text{(Ans.)}$$

$$\text{and (ii) Area, } A = l \times b = 8 \text{ cm} \times 7 \text{ cm} = 56 \text{ cm}^2 \quad \text{(Ans.)}$$

### Example 7 :

The area of a rectangular field is  $450 \text{ m}^2$  and its width is 25 m.

Find : (i) its length (ii) its perimeter  
(iii) the cost of fencing the field at the rate of ₹ 35.50 per metre.

### Solution :

$$\text{(i) Length} = \frac{\text{Area}}{\text{Breadth}} = \frac{450}{25} \text{ m} = 18 \text{ m} \quad \text{(Ans.)}$$

$$(ii) \quad \text{Perimeter} = 2(l + b) = 2(18 + 25) \text{ m} = 2 \times 43 \text{ m} = 86 \text{ m} \quad (\text{Ans.})$$

$$(iii) \quad \text{Cost of fencing} = \text{Length of fence} \times \text{Rate}$$

$$= 86 \times ₹ 35.50$$

$$= ₹ 3,053$$

$$\text{Length of fence} = \text{Perimeter} = 86 \text{ m}$$

(Ans.)

### EXERCISE 23(A)

1. The sides of a triangle are 3 cm, 4 cm and 5 cm long. Find its perimeter.
2. The lengths of the sides of a triangular field are 15 m, 20 m and 24 m. Find the total distance travelled by a boy moving along its boundary in making :
  - (i) one complete round
  - (ii) 7 complete rounds.
3. The perimeter of a square is 52 cm. Find the length of one of its sides and also its area.
4. The area of a square is  $225 \text{ m}^2$ . Find the length of one of its sides and also its perimeter.
5. A square field has a side of 160 m length. Find its area and the cost of levelling it at the rate of ₹ 5 per square metre.
6. The area of a square field is  $576 \text{ m}^2$ . Find :
  - (i) the length of its side.
  - (ii) the length of its perimeter.
  - (iii) the cost of fixing a fence along the boundary of the field at the rate of ₹ 3.20 per metre.
7. A rectangular carpet is 4.5 m long and 3.2 m wide; find :
  - (i) its area.
  - (ii) the cost of the carpet at the rate of ₹ 36 per square metre.
8. The perimeter of a rectangular field is 64 m. If its length is 20 m, find :
  - (i) its breadth
  - (ii) its area
9. The perimeter of a rectangular field is 86 m. If its breadth is 25 m, find :
  - (i) its length
  - (ii) its area.
10. The area of a rectangle is  $260 \text{ cm}^2$ . If its length is 20 cm, find :
  - (i) its breadth
  - (ii) its perimeter
11. The area of a rectangular field is  $300 \text{ m}^2$ . If its breadth is 15 m, find :
  - (i) its length
  - (ii) its perimeter
12. The floor of a room is square in shape. If the length of one side of the room is 2.6 m, find :
  - (i) the area of the floor.
  - (ii) the cost of carpeting the room at the rate of ₹ 40 per square metre.
13. An agricultural field is rectangular in shape. If its length is 200 m and width 125 m, find :
  - (i) its area.
  - (ii) the cost of ploughing the field at the rate of 60 paise per square metre.
14. A playground is rectangular in shape. If its length is 60 m and width 45 m, find :
  - (i) its perimeter.
  - (ii) the cost of fencing it at the rate of ₹ 2.50 per metre.
15. A boy makes one round along the boundary of a rectangular field in 20 minutes. The field is 160 m long and 124 m wide. Find :
  - (i) the perimeter of the field
  - (ii) the distance moved by the boy
  - (iii) the speed (in  $\text{ms}^{-1}$ ) at which the boy runs.

**Example 8 :**

A square and a rectangle have equal areas. If each side of the square is 18 m and the width of the rectangle is 12 m, find :

- (i) the area of the square  
 (ii) the length of the rectangle  
 (iii) the perimeter of the rectangle

**Solution :**

(i) Since each side of the square = 18 m  
 $\therefore$  **Area of square** = (side)<sup>2</sup>  
 $= (18 \text{ m})^2 = 324 \text{ m}^2$  (Ans.)

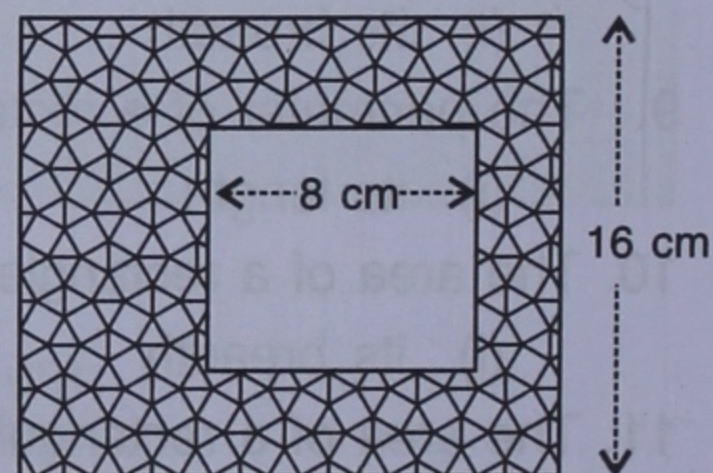
(ii) Given, area of rectangle = area of square  
 $\therefore$  **Area of rectangle** = 324 m<sup>2</sup>,  
*i.e.* length of rectangle  $\times$  its breadth = 324 m<sup>2</sup> Area = length  $\times$  breadth  
 $\Rightarrow$  length of rectangle  $\times$  12 m = 324 m<sup>2</sup>

So, **length of rectangle** =  $\frac{324}{12}$  m = 27 m (Ans.)

(iii) **Perimeter of rectangle** = 2(length + breadth)  
 $= 2(27 \text{ m} + 12 \text{ m})$   
 $= 78 \text{ m}$  (Ans.)

**Example 9 :**

The adjoining figure shows a shaded portion, enclosed by two squares. If the sides of the squares are 16 cm and 8 cm, respectively, find the area of the shaded portion.

**Solution :**

Since area of the bigger (outer) square = (side)<sup>2</sup>  
 $= (16 \text{ cm})^2 = 256 \text{ cm}^2$

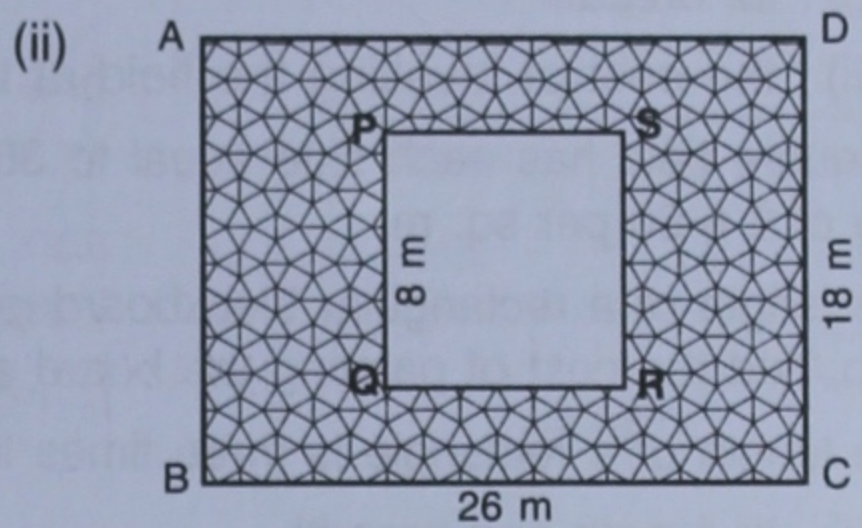
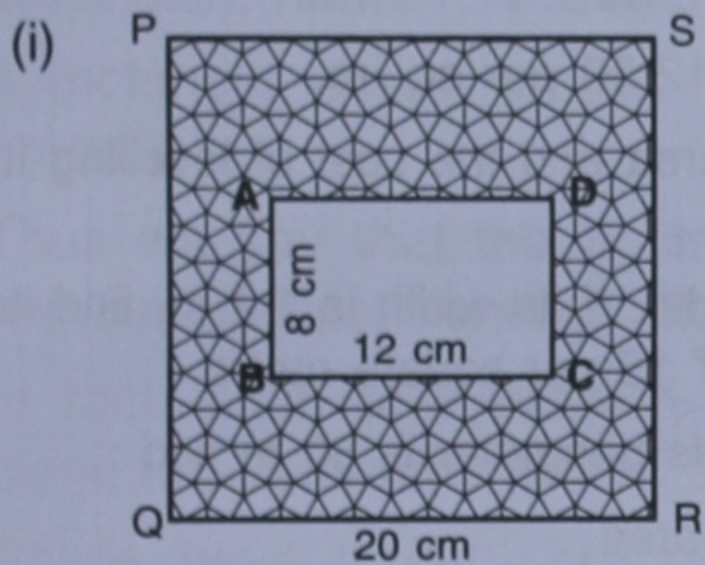
And, area of the smaller (inner) square = (8 cm)<sup>2</sup>  
 $= 64 \text{ cm}^2$

$\therefore$  **Area of the shaded portion** = Area of the bigger square – Area of the smaller square  
 $= 256 \text{ cm}^2 - 64 \text{ cm}^2 = 192 \text{ cm}^2$  (Ans.)

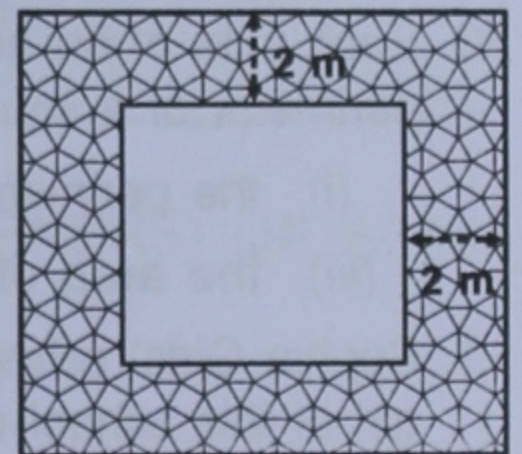
**EXERCISE 23(B)**

1. The area of a square is the same as the area of a rectangle. If each side of the square is 24 cm and the breadth of the rectangle is 18 cm, find :
- (i) the area of the rectangle  
 (ii) the length of the rectangle  
 (iii) the perimeter of the rectangle

- The area of a rectangle is the same as the area of a square. If the length and the breadth of the rectangle are 8 cm and 4.5 cm, respectively, find :
  - the area of the square.
  - the side of the square.
  - the perimeter of the square
- The length of a rectangle is 24 cm and breadth 16 cm. Find its perimeter; Also, if the perimeter of a square is the same as the perimeter of this rectangle, find :
  - the length of a side of the square.
  - the area of the square.
- The length and the breadth of a rectangle are 24 cm and 18 cm, respectively, whereas the length of each side of a square is 20 cm. Find :
  - the difference between the perimeters of the given rectangle and square.
  - the difference between their areas.
- In each of the following figures, ABCD is a rectangle and PQRS is a square. Find, in each case, the area of the shaded portion :

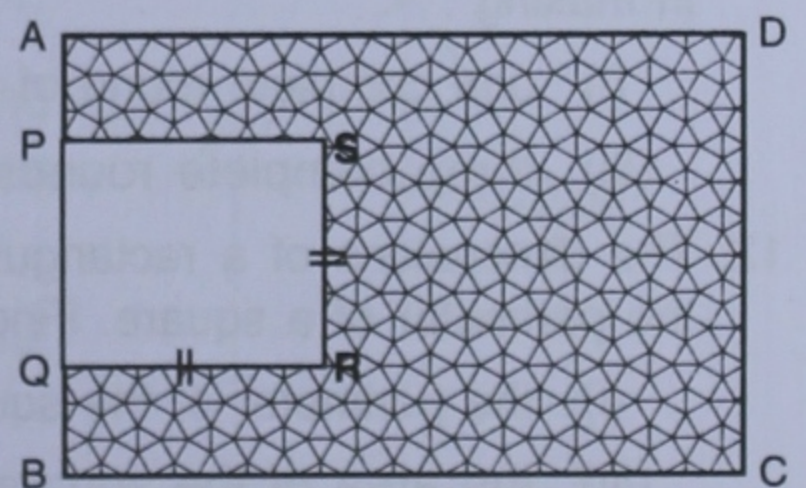


- The shaded portion in the adjoining figure has uniform width of 2 m and is enclosed by two squares. If each side of the outer (bigger) square is 9 m, find the area of the shaded portion.

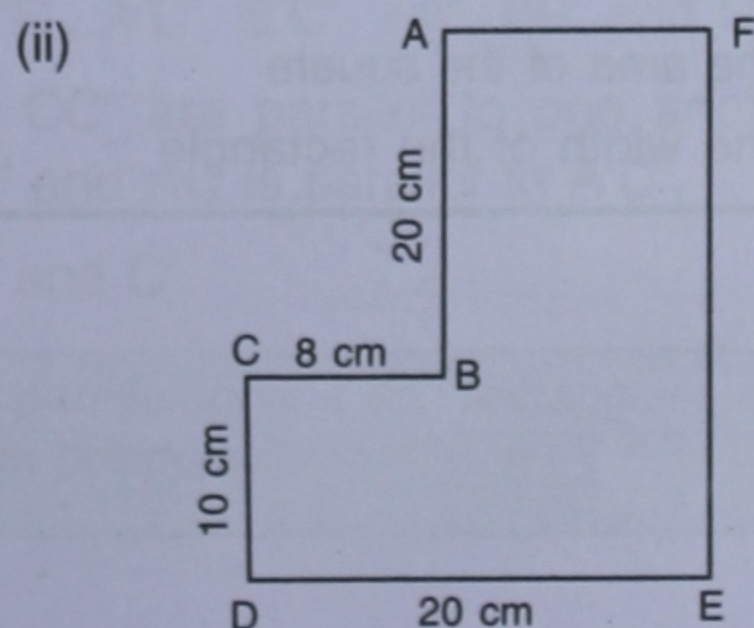
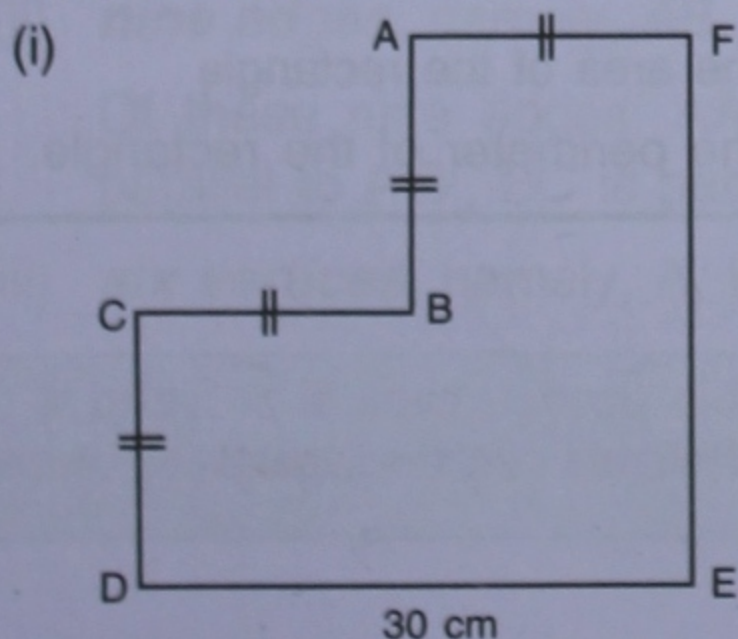


- In the figure given alongside ABCD is a rectangle and PQRS is a square. Find the area of the shaded portion if :

$$\begin{aligned} BC &= 16 \text{ m,} \\ AB &= 12 \text{ m,} \\ \text{and } AP &= BQ = 3 \text{ m.} \end{aligned}$$



- Find the area and the perimeter of each figure, given below in which all the lengths are in cm and the angle at each vertex is  $90^\circ$ .



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**Revision Exercise (Chapter 23)**

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1. Find the perimeter and the area of a rectangle whose length is 20 cm, and breadth is 75% of its length.
  2. Find the length and the perimeter of a rectangular field whose area is  $624 \text{ m}^2$  and breadth is 24 m.
  3. Find the breadth and the perimeter of a rectangular field with area  $1350 \text{ m}^2$  and length 45 m.
  4. The area of a rectangle is  $768 \text{ cm}^2$  and its length and breadth are in the ratio 4 : 3. Find its length, breadth and perimeter.
  5. Find the cost of fencing a rectangular field with length 32 m and breadth 25 m if the rate of fencing is ₹ 40 per m.
  6. A rectangular field has perimeter 152 m and length 48 m. Find :
    - (i) its breadth
    - (ii) its area
    - (iii) the cost of levelling the field at the rate of ₹ 12.50 per sq. m.
  7. A square field has each side equal to 36 m. Find its area and the cost of levelling it at the rate of ₹ 5.60 per sq. m.
  8. The length of a rectangular blackboard is double its width. If its width is 1.2 m, find its area. Also, find the cost of painting the board at the rate of ₹ 15 per square metre.
  9. The length of a rectangle is three times its breadth. If its perimeter is 80 m find :
    - (i) its length and breadth.
    - (ii) its area
  10. Each side of an equilateral triangle is 20 cm. If the perimeter of this triangle is equal to the perimeter of a square, find :
    - (i) the perimeter of the square
    - (ii) each side of the square
    - (iii) the area of the square.
  11. Sophia Girls' school has a rectangular playground with length = 80 m and width = 60 m. A girl of this school runs along the boundary of the playground. Find the distance she will run in making :
    - (i) one complete round of the playground
    - (iii) three complete rounds of the playground.
  12. The dimensions of a rectangular body are 25 cm and 15 cm, and its perimeter is equal to the perimeter of a square. Find :
    - (i) the perimeter of the square
    - (ii) each side of the square
    - (iii) the area of the square.
  13. Each side of a square is 20 cm and its area is equal to the area of a rectangle with length 25 cm. Find :
    - (i) the area of the square
    - (ii) the area of the rectangle
    - (iii) the width of the rectangle
    - (iv) the perimeter of the rectangle.
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