

15 | Mensuration

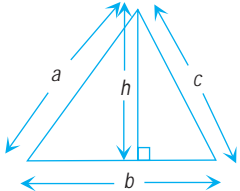
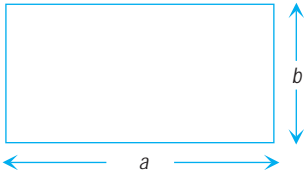
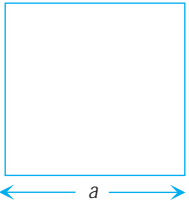
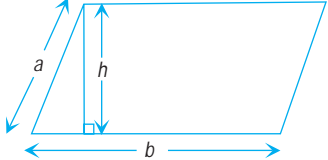
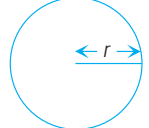
INTRODUCTION

In class VII, you have learnt about the perimeter and area of closed plane figures such as triangles, squares, rectangles, parallelograms and circles. You have also learnt to find the area between two rectangles *i.e.* area of pathways or borders and area between two concentric circles.

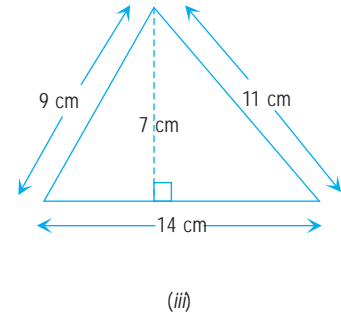
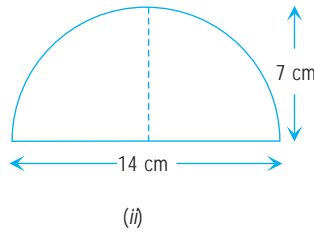
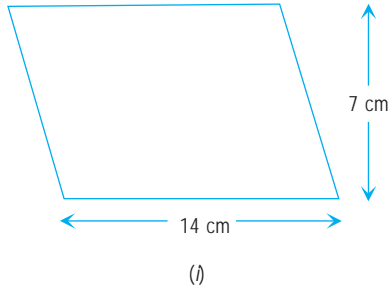
In this chapter, we will learn to find the area and perimeter of some more plane figures like trapeziums, quadrilaterals and polygons. We shall also learn the concept of volume, measurement of volume using a basic unit, volume and surface area of cube, cuboid and cylinder, volume and capacity.

AREA AND PERIMETER OF SOME PLANE FIGURES

Let us recall the area and perimeter of some plane figures.

Plane figure	Name	Area	Perimeter
	Triangle	$\frac{1}{2} b \times h$	$a + b + c$
	Rectangle	$a \times b$	$2(a + b)$
	Square	a^2	$4a$
	Parallelogram	$b \times h$	$2(a + b)$
	Circle	πr^2	$2\pi r$

■ **Example 1.** Find the area of the following figures:



Solution.

(i) Given plane figure is a parallelogram.

$$\begin{aligned} \text{Area of parallelogram} &= \text{base} \times \text{height} \\ &= (14 \times 7) \text{ sq. cm} = 98 \text{ sq. cm} \end{aligned}$$

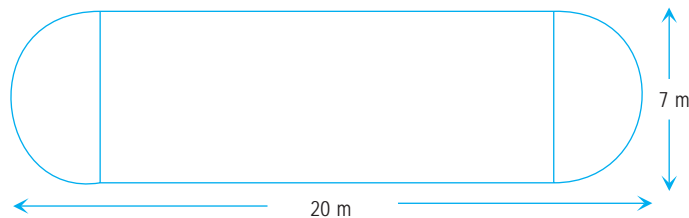
(ii) Given plane figure is a semicircle.

$$\begin{aligned} \text{Area of semicircle} &= \frac{1}{2}\pi r^2 \\ &= \left(\frac{1}{2} \times \frac{22}{7} \times 7^2\right) \text{ cm}^2 && \left(\because r = \frac{14}{2} \text{ cm} = 7 \text{ cm}\right) \\ &= 77 \text{ cm}^2 \end{aligned}$$

(iii) Given plane figure is a triangle.

$$\begin{aligned} \text{Area of triangle} &= \frac{1}{2}b \times h \\ &= \left(\frac{1}{2} \times 14 \times 7\right) \text{ cm}^2 = 49 \text{ cm}^2. \end{aligned}$$

■ **Example 2.** The shape of a garden is rectangular in the middle and semicircular at the ends as shown in the diagram. Find the area and the perimeter of this garden.



Solution. Radius of semicircular ends = $\frac{1}{2} \times \text{diameter}$

$$= \left(\frac{1}{2} \times 7\right) \text{ m} = 3.5 \text{ m}$$

$$\text{Length of rectangle} = (20 - (3.5 + 3.5)) \text{ m} = 13 \text{ m}$$

$$\text{Breadth of rectangle} = 7 \text{ m}$$

∴

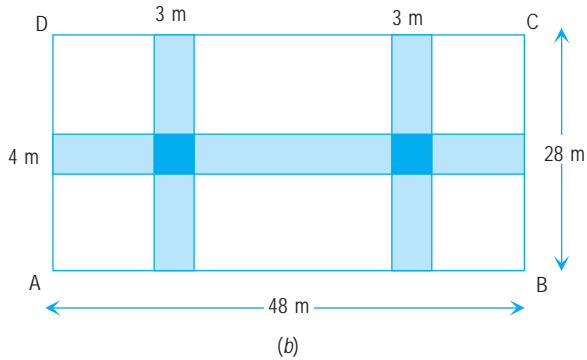
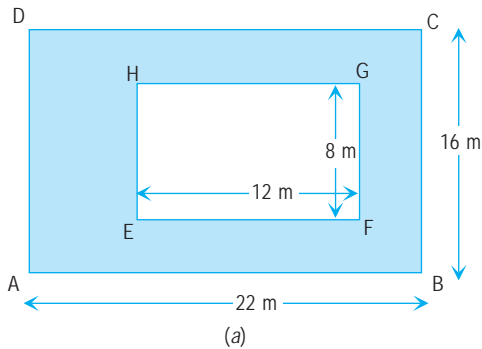
Area of garden = area of rectangle + area of two semicircles

$$\begin{aligned} &= l \times b + 2 \times \frac{\pi r^2}{2} \\ &= (13 \times 7) \text{ m}^2 + \frac{22}{7} \times (3.5)^2 \text{ m}^2 \\ &= 91 \text{ m}^2 + 38.5 \text{ m}^2 \\ &= 129.5 \text{ m}^2 \end{aligned}$$

Perimeter of the garden consists of two line segments, each of length 13 m and two semicircles of radius 3.5 m.

$$\begin{aligned}\therefore \text{Perimeter of garden} &= (2 \times 13) \text{ m} + 2 \times \left(\frac{1}{2} \times 2\pi r\right) \\ &= 26 \text{ m} + \left(2 \times \frac{22}{7} \times 3.5\right) \text{ m} \\ &= 26 \text{ m} + 22 \text{ m} = 48 \text{ m}.\end{aligned}$$

■ **Example 3.** Find the area of the (i) shaded part (ii) unshaded part of the following figures, given that all adjacent sides are at right angles:



Solution.

$$(a) \text{ Area of rectangle } ABCD = (22 \times 16) \text{ m}^2 = 352 \text{ m}^2$$

$$\text{Area of rectangle } EFGH = (12 \times 8) \text{ m}^2 = 96 \text{ m}^2$$

$$\begin{aligned}(i) \text{ Area of shaded part} &= \text{area of rectangle } ABCD - \text{area of rectangle } EFGH \\ &= (352 - 96) \text{ m}^2 = 256 \text{ m}^2\end{aligned}$$

$$(ii) \text{ Area of unshaded part} = \text{area of rectangle } EFGH = 96 \text{ m}^2$$

$$(b) (i) \text{ Area of shaded portion parallel to length} = (48 \times 4) \text{ m}^2 = 192 \text{ m}^2$$

$$\begin{aligned}\text{Area of shaded portion parallel to breadth} &= 2 \times (28 \times 3) \text{ m}^2 = 2 \times 84 \text{ m}^2 \\ &= 168 \text{ m}^2\end{aligned}$$

$$\text{Area of dark portion} = 2 \times (4 \times 3) \text{ m}^2 = 24 \text{ m}^2$$

$$\begin{aligned}\therefore \text{Area of shaded portion} &= 192 \text{ m}^2 + 168 \text{ m}^2 - 24 \text{ m}^2 \\ &= 336 \text{ m}^2\end{aligned}$$

(We have subtracted the area of the dark shaded portion because it has occurred twice—firstly when considering area parallel to length and secondly when considering area parallel to breadth.)

$$(ii) \text{ Area of rectangle } ABCD = (48 \times 28) \text{ m}^2 = 1344 \text{ m}^2$$

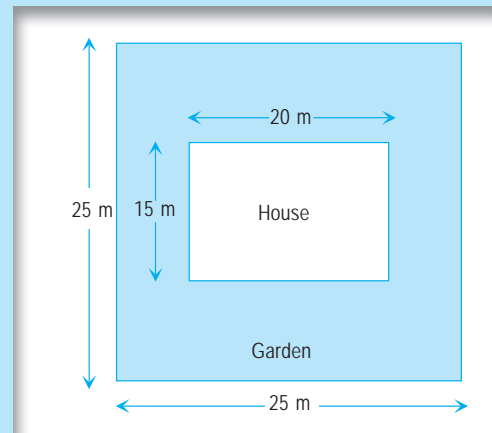
$$\begin{aligned}\therefore \text{Area of unshaded part} &= \text{area of rectangle } ABCD - \text{area of shaded part} \\ &= 1344 \text{ m}^2 - 336 \text{ m}^2 \\ &= 1008 \text{ m}^2.\end{aligned}$$

Exercise 15.1

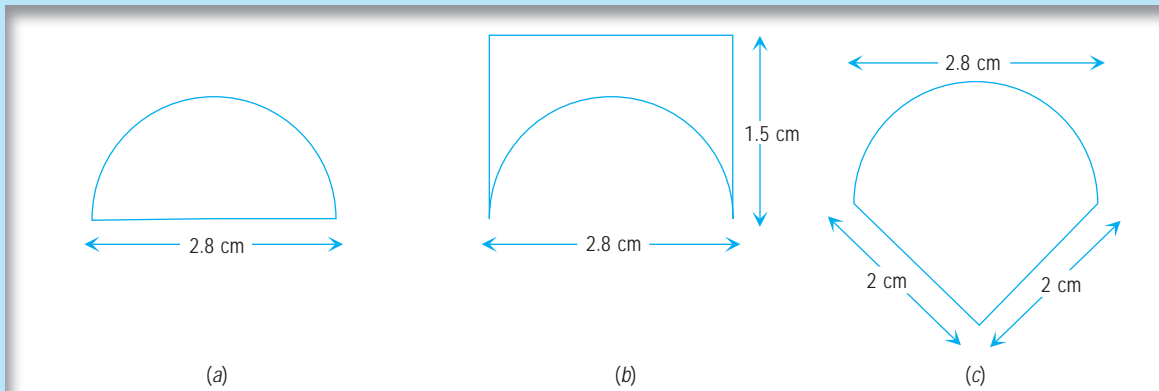
- The length and breadth of a rectangular field are in the ratio 9 : 5. If the area of the field is 14580 square metre, find the cost of surrounding the field with a fence at the rate of ₹ 3.25 per metre.
- Find the cost of flooring a room 6.5 m by 5 m with square tiles of side 25 cm at the rate of ₹ 1880 per hundred tiles.

- A rectangle is 16 m by 9 m. Find a side of the square whose area equals the area of the rectangle. By how much does the perimeter of the rectangle exceed the perimeter of the square?
- Two adjacent sides of a parallelogram are 24 cm and 18 cm. If the distance between longer sides is 12 cm, find the distance between shorter sides.

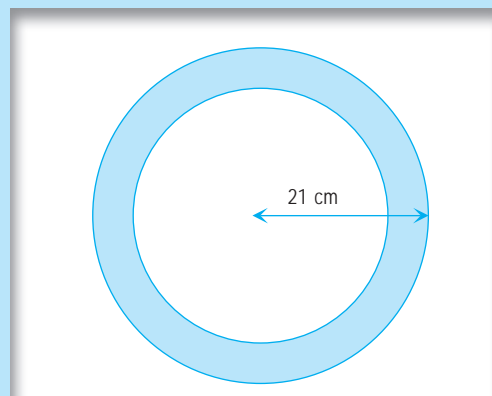
- Mrs. Kaushik has a square plot with the measurement as shown in the adjoining figure. She wants to construct a house in the middle of the plot. A garden is developed around the house. Find the total cost of developing a garden around the house at the rate of ₹ 55 per m^2 .



- A flooring tile has a shape of parallelogram whose base is 24 cm and the corresponding height is 10 cm. How many such tiles are required to cover a floor of area 1080 m^2 ? (If required you can split the tiles in whatever way you want to fill up the corners).
- An ant is moving around a few food pieces of different shapes scattered on the floor. For which food piece would the ant have to take a longer round?



- In the adjoining figure, the area enclosed between the concentric circles is 770 cm^2 . If the radius of the outer circle is 21 cm, calculate the radius of the inner circle.



- A bicycle wheel has a diameter (including the tyre) of 70 cm. How many times would the wheel rotate to cover a distance of 4.4 km?
- A copper wire when bent in the form of a square encloses an area of 121 cm^2 . If the same wire is bent into the form of a circle, find the area of the circle.