



- Area of rectangular path.
- Area of triangular region.
- Area of field like parallelogram region.
- Area of rhombus region.
- Total surface area of cube and cuboid.

12.1 Introduction

You are familiar with different figures like triangle, rectangle, square, parallelogram, Rhombus etc. made on plane surface. You are also familiar with the figure of surfaces of cube and cuboid among solid bodies.

You can see length of the boundary of different closed figure is different. You know that every closed figure occupy some part of his plane which is called area enclosed by that figure. Thus in which physical quantity we represent the length of the boundary is called perimeter. So perimeter is a distance around the closed figure, while area represents measurement of region of surface enclosed by a closed figure.

Often we see that some places are left for path around the field, park, religious places or garden etc. In the same way after framing of painting or figures some places are left. To find out the expenditure for making path or border it is necessary to find out the area of these. In this unit your will study the method to find out the perimeter and area closed by plane figures like rectangle, triangle, square, parallelogram, rhombus etc. Together with you will study the perimeter and area of surfaces of cube and cuboid among solid figures.

12.2 Perimeter and Area of rectangle and square:

Perimeter of rectangle:

We know that :

Perimeter of rectangle = Sum of the length of four sides.

In fig. 12.1 length of rectangle = l

$$\begin{aligned}\text{Breadth of rectangle} &= b \\ \text{Perimeter of rectangle} &= (l + l + b + b) \\ &= (2l + 2b) \\ &= 2(l + b)\end{aligned}$$

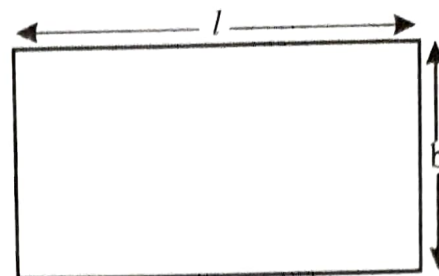


Fig. 12.1

Area of Rectangular region:

As we use unit 1 cm. to measure the length of line segment, measure of which is printed on scale, in the same way for calculation of area we use unit square cm or cm^2 . Meaning of this is the area surrounded by such square whose sides are 1cm. Similarly, meaning of area of 1m^2 is such region which is surrounded by a square whose sides are 1 m. With the help of graph can we say what will be the area of rectangular region whose length is 5cm and breadth is 3cm.

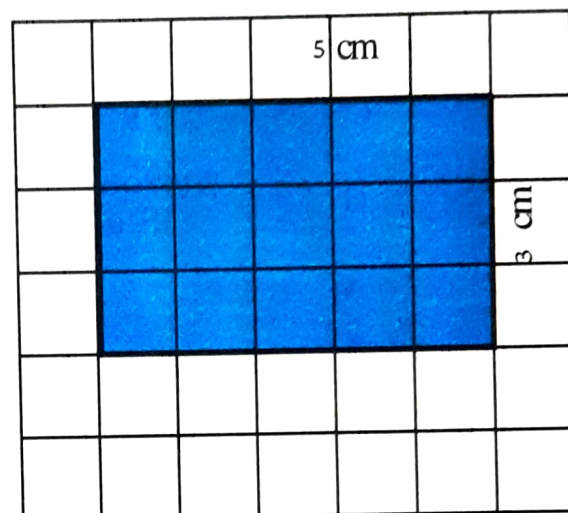


Fig. 12.2

Make a rectangular region on graph paper on which there are square of $1\text{cm} \times 1\text{cm}$ (see fig 12.2). This rectangular region cover 15 square completely.

$$\text{Area of rectangular region} = 15\text{cm}^2$$

We can write this like 5×3 square cm
(Length $\times$ Breadth)

Do these

Here we are given measure of sides of some rectangle. Put this on graph paper and count the number of squares covered by this and find out the area of the region surrounded by this.

Length	Breadth	Area
3cm	2cm	.....
5cm	4cm	.....
6cm	5cm	.....

What result we find to do this?

We seen that:

$$\text{Area of rectangular region} = \text{Length} \times \text{breadth}$$

Is it possible that without using graph paper, we can find the area of that rectangular region whose length is 6cm and breadth is 4cm?

Yes, this is possible.

$$\begin{aligned}\text{Area of rectangular region} &= \text{Length} \times \text{breadth} \\ &= 6 \text{ cm} \times 4 \text{ cm} \\ &= 24 \text{ cm}^2\end{aligned}$$

Perimeter of rectangle	$= 2 (\text{Length} + \text{breadth})$
Area of rectangular region	$= \text{Length} \times \text{breadth}$

Try:

1. Find the area of rectangular surface of your classroom.
2. Find out the area of any door of your home.

Perimeter of square and area of square:

In Fig. 12.3, the sides of square = a cm

$$\begin{aligned}\text{Perimeter of square} &= \text{sum of four sides} \\ &= (a + a + a + a) \\ &= 4a \text{ cm.}\end{aligned}$$

$$\therefore \text{Perimeter of square} = 4 \times \text{side}$$

$$\begin{aligned}\text{Area of square} &= \text{side} \times \text{side} \\ &= a \times a \\ &= a^2\end{aligned}$$

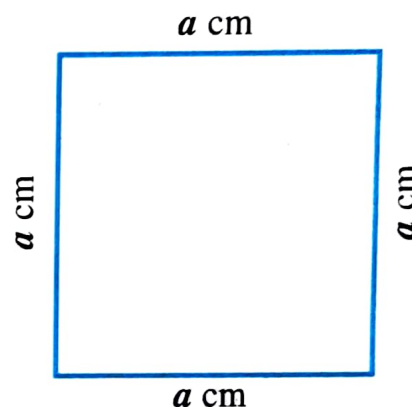


Fig. 12.3

Perimeter of square = $4 \times \text{Side}$, Area of square = Side^2

Unit of Area

Side of a square is 1 cm What area of square will be surrounded by this?

$$\therefore \text{Area of square} = (1\text{cm})^2 = 1\text{cm}^2$$

We can say above statement like this

$$\therefore 1 \text{ cm} = 10 \text{ mm}$$

$$\begin{aligned}\therefore \text{Area of square} &= (10 \text{ mm})^2 \\ &= 100 \text{ mm}^2\end{aligned}$$

You saw that both are the area of same region.

$$\text{So, } 1\text{cm}^2 = 100\text{ mm}^2$$

Do this

$$\begin{array}{ll} 1 \text{ decimeter} = 10 \text{ cm,} & \text{So } 1 \text{ decimeter}^2 = 100 \text{ cm}^2 \\ 1 \text{ m} = 10 \text{ decimeter,} & \text{So } 1\text{m}^2 = 100 \text{ decimeter}^2 \\ 1 \text{ decameter} = 10 \text{ m,} & \text{So } 1 \text{ decameter}^2 = 100 \text{ m}^2 \end{array}$$

We also know that measurement of land is in are and hectare.

$$\begin{aligned} \therefore 1 \text{ are} &= 100 \text{ m}^2 \\ 1 \text{ hectare} &= 100 \times 100 \text{ m}^2 \\ &= 10000 \text{ m}^2 \end{aligned}$$

Example 1. Shaina takes 3 round, around a field like a square whose every side is of 70m. Find the distance covered by him.

Solution : Perimeter of square

$$= 4 \times \text{length of one side}$$

$$= 4 \times 70 \text{ m} = 280 \text{ m}$$

$$\text{So distance cover in one round} = 280\text{m}$$

$$\text{So distance cover in three round} = 3 \times 280\text{m} = 840\text{m}$$

Example 2. Pinki takes one round around a square shaped field whose measure of one side is 75m Bob takes one round around the rectangular field whose length is 160m and breadth is 50m. In both who cover more distance and how much?

Solution : Distance covered in one round by Pinki

$$= \text{Perimeter of square}$$

$$= 4 \times \text{length of one side}$$

$$= 4 \times 75\text{m} = 300\text{m}.$$

Distance covered by Bob in one round

$$= \text{Perimeter of rectangle}$$

$$= 2 \times (\text{length} + \text{breadth})$$

$$= 2(160\text{m} + 50\text{m})$$

$$= 2 \times 210 \text{ m} = 420 \text{ m}$$

Difference in both distance

$$= 420 - 300$$

$$= 120\text{m.}$$

So, Bob covered 120m more distance

Example 3. Find out the area of the rectangle whose sides are 12m and 5m respectively.

Solution : Length of rectangle = 12m
Breath of rectangle = 5m
 $\therefore$ Area of rectangle = length $\times$ breadth
= 12m $\times$ 5m
= 60m²

Example 4. Find out the area of a square whose one side is 9m.

Solution : Side of square = 9m
Area of square = side $\times$ side
= 9m $\times$ 9m
= 81 m²

Example 5. Area of a rectangular thick paper is 117 cm². If the length of this is 13 cm, then find out its breadth.

Solution : Area of rectangular region = 117 cm²
length = 13cm
breath = ?
Area of rectangular region = length $\times$ breadth
 $\therefore$ Breadth = $\frac{\text{Area of rectangle}}{\text{length}} = \frac{117}{13} \text{ cm} = 9 \text{ cm}.$

Exercise 12(a)

1. Find out the perimeter of the following figure:

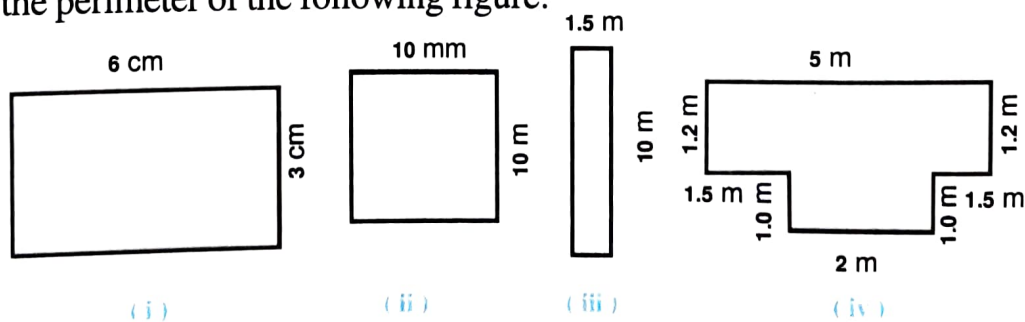


Fig. 12.4

2. Find out the area of the figures which are given in question 1.

3. Fill in the blanks of following table:

Serial No.	Rectangular Region			
	Length	Breadth	Perimeter	Area
(i)	5m	...	...	20m^2
(ii)	8m	...	...	24m^2
(iii)	5cm	...	18cm	...
(iv)	...	30cm	480cm	...

4. In the Nisha's school the length and breadth of play ground is 60m and 50m respectively. Find out the area of play ground in are.
5. Length and breath of Avinash's Agriculture form in 240m and 110m respectively, find out the area of agriculture form in hectare.
6. Area of a rectangular field is 0.5 hectare. If the one side of this field is 125m, then find adjacent side
7. One side of a square tile is 12cm. Find the area and perimeter of the tile
8. Ratio of length and breadth of rectangular field is 3:2. Find the expenditure for making boundary around the field, at the rate of expenditure rate is ₹1.50 per metre while area of the field is 1.5 hectare.
9. 15 doors of an office to be masticated. The length of every door is 2.5m and breath is 1.2m. If the expenditure with price of khas ₹105.0 per m^2 , then what will be total expenditure.

12.3 Application of Area

1. Area of rectangular path:

Generally some places are left around or in the middle of field, for path. To find the area of this type of path, method of finding the area of rectangular region is used.

See this

Look at the following figure 12.5 (i) and (ii). Both figure are rectangular field. The length of every field is 40m and breadth is 30m.

The length of path which is made around it is 2m. In fig (i) the dotted path is inside the field and in fig. (ii) dotted path is outer side of the field.

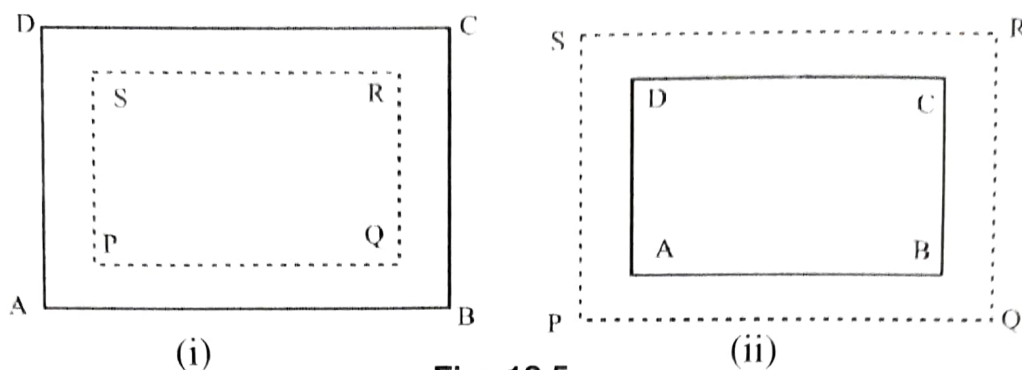


Fig. 12.5

In fig. (i) and (ii) there is grass except path. We have to find out the area of path in every field.

● Area of path in fig (1)

In fig 12.6 there is a field ABCD. It is shaded path inside it the breadth of path is 2m.

Except path rest part is denoted by rectangle PQRS. The grass is in this portion. We have to find out the length and breadth of rectangle PQRS.

$$\begin{aligned}\text{Length of this} &= 40\text{m} - (2\text{m} + 2\text{m}) \\ &= 40\text{m} - 4\text{m} \\ &= 36\text{m}\end{aligned}$$

$$\begin{aligned}\text{Breath of rectangle PQRS} &= 30\text{m} - (2\text{m} + 2\text{m}) \\ &= 30\text{m} - 4\text{m} \\ &= 26\text{m}\end{aligned}$$

$$\begin{aligned}\text{So, area of grass land} &= \text{length} \times \text{breadth} \\ &= 36\text{m} \times 26\text{m} \\ &= 936 \text{ m}^2\end{aligned}$$

$$\begin{aligned}\text{Area of rectangle ABCD} &= \text{length} \times \text{breadth} \\ &= 40\text{m} \times 30\text{m} \\ &= 1200\text{m}^2\end{aligned}$$

$$\begin{aligned}\text{So, area of path} &= \text{Area of rectangle ABCD} - \text{Area of grassland} \\ &= 1200\text{m}^2 - 936\text{m}^2 \\ &= 264 \text{ m}^2\end{aligned}$$

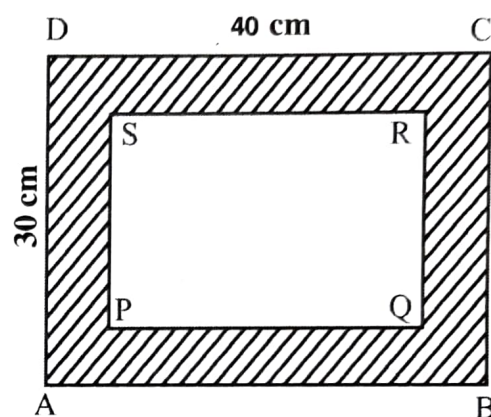


Fig. 12.6

● Area of path in fig. (ii):

In fig. 12.7 there is a field ABCD. Length and Breadth of this is 40m and 30m respectively.

$$\begin{aligned}\text{Area of field} &= 40\text{m} \times 30\text{m} \\ &= 1200 \text{ m}^2\end{aligned}$$

There is a path outside the field whose breadth is 2m. Thus together with path new rectangles is PQRS is made.

$$\begin{aligned}\text{Length of rectangle PQRS} &= 40\text{m} + (2\text{m} + 2\text{m}) \\ &= 40\text{m} + 4 \text{ m} \\ &= 44\text{m}\end{aligned}$$

$$\begin{aligned}\text{Breath of rectangle PQRS} &= 30\text{m} + (2\text{m} + 2\text{m}) \\ &= 30\text{m} + 4\text{m} \\ &= 34\text{m}.\end{aligned}$$

$$\begin{aligned}\text{So, area of rectangle PQRS} &= 44\text{m} \times 34\text{m} \\ &= 1496\text{m}^2\end{aligned}$$

$$\begin{aligned}\text{So, area of patch} &= \text{Area of rectangle PQRS} - \text{Area of rectangle ABCD} \\ &= 1496\text{m}^2 - 1200\text{m}^2 \\ &= 296\text{m}^2\end{aligned}$$

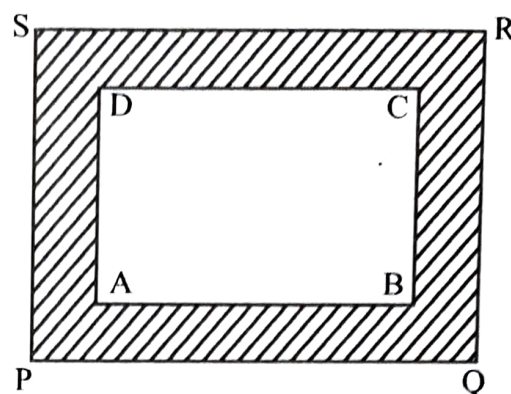


Fig. 12.7

We saw

1. In fig. 12.6 path is inside the field. So for finding the length and breadth of inner rectangle we subtract double of the breadth of path from length and breadth of the original rectangle.
2. In fig. 12.7 path is outside. So, to find the length and breadth of the exterior rectangle we add double the breadth of path in the length and breadth of original rectangle.

Example 6. A rectangular field has the length 45m, breadth 30m. Outside of the field there is a path of breadth 2.5m. Find the area of path.

Solution: Fig 12.8 shows ABCD is a rectangular field and shaded portion shows breadth of path is 2.5m.

To find the area of the path we have to get
(Area of rectangle PRQS – Area of rectangle ABCD)

We have $PQ = (45 + 2.5 + 2.5)m = 50m$

$PS = (30 + 2.5 + 2.5)m = 35m$

Area of rectangle ABCD = $l \times b$

$= (45 \times 30) m^2$

$= 1350m^2$

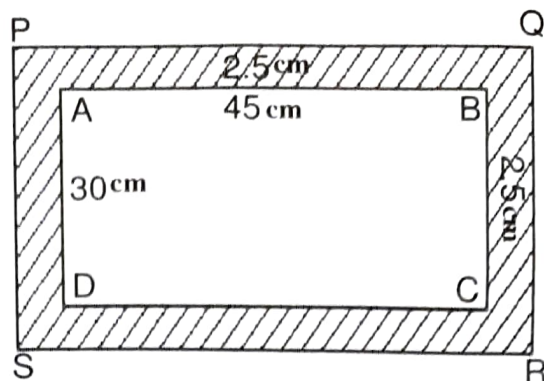


Fig. 12.8

Area of path = Area of rectangle PQRS – Area of rectangle ABCD

$= (1750 - 1350)m^2$

$= 400m^2$.

Example 7. There is a field like square whose side is 100m. There is a path of breadth 5m inside the field. Find out the area of this path. Also find the expenditure for doing cement on the path at the rate of ₹2500 per/10m².

Solution : In fig. 12.9, we see the square ABCD whose side is 100m long and shaded portion is a part of breadth 5m.

Here

$PQ = 100 - (5 + 5) = 90m$.

Area of square ABCD = Side = $(100)^2m^2$
 $= 10,000 m^2$

Area of square PQRS = side²
 $= 90^2m^2$
 $= 8,100m^2$

So, Area of path = $(10000 - 8100)m^2 = 1900m^2$

Since expenditure for doing cement on 10m² = ₹2500

So, expenditure for doing on 1m² = ₹ $\frac{2500}{10}$

So, expenditure for doing on 1900m² = ₹ $\frac{2500}{10} \times 1900$
 $= ₹4,75000$.

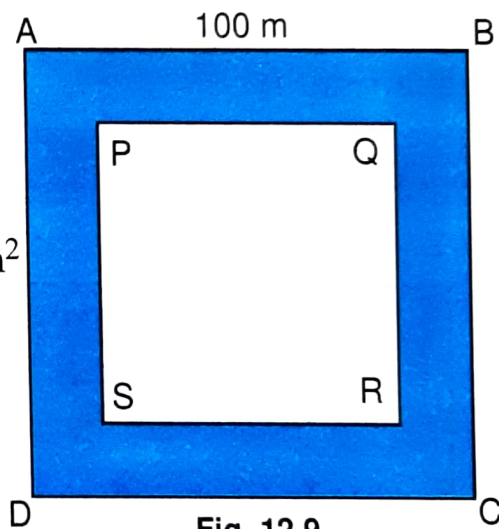


Fig. 12.9

Exercise 12(b)

- Find out length and breadth of inner rectangle in fig. 12.10

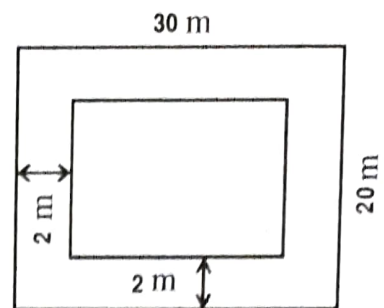


Fig. 12.10

- Find out length and breadth of outer rectangle in fig. 12.11

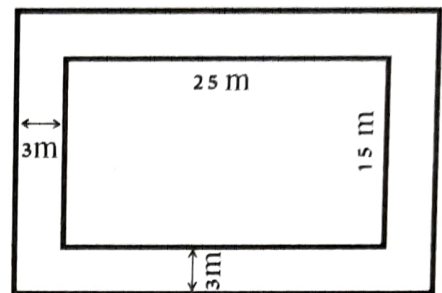


Fig. 12.11

- In fig. 12.12 the breadth of shaded path is 3m after finding area cover by large rectangle, area cover by small rectangle and area of path fill in the blanks.

- Area cover by large rectangle is
- Area cover by small rectangle is
- Area of shaded path is

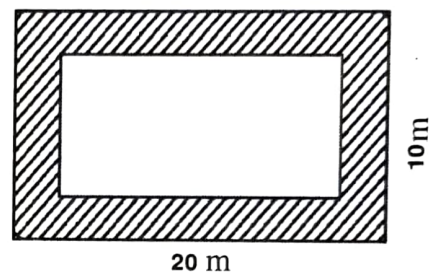


Fig. 12.12

- Length and breadth of a hall is 20m and 8m. Its wall are decorated by stone of breadth 2m. Make a fig. on your exercise book and find the area of decorated portion.
- There is a path of breadth 50 cm around the square shape orchard . Length of orchard with path is 51m. Find the area of orchard.

12.4 Area of the path intersecting perpendicular in middle of rectangular region:

Example 8. Length and breadth of a rectangular grassland is 80m and 60m. In middle of grassland there are two perpendicular path of breadth 4m intersecting to each other every path is parallel to side of rectangle. Find the area of total path.

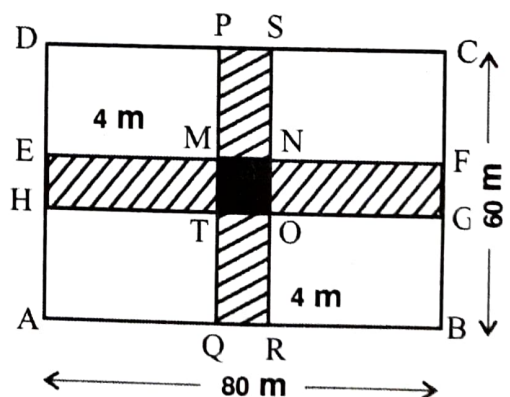


Fig. 12.13

Solution:

$$\begin{aligned}\text{In fig. 12.13, Area of path EFGH} &= 80 \times 4\text{m}^2 \\ &= 320\text{m}^2\end{aligned}$$

(area of square MNOT is also included in this area)

$$\begin{aligned}\text{Area of path PQRS} &= 60 \times 4\text{m}^2 \\ &= 240\text{m}^2\end{aligned}$$

(area of square MNOT is also included in this area)

$$\begin{aligned}\text{Area of common square MNOT (situated on both path)} &= 4 \times 4\text{ m}^2 \\ &= 16\text{m}^2\end{aligned}$$

Since area of square MNOT 16m^2 is included in both area of path.

$$\begin{aligned}\text{So, area of total path} &= (320 + 240 - 16)\text{m}^2 \\ &= (560 - 16)\text{m}^2 \\ &= 544\text{m}^2\end{aligned}$$

In fig 12.13 we have seen that shaded part is situated at both path so,

To find out the total area of path intersecting to each other, we subtract common area of paths from the total area of path.

Exercise 12 (c)

1. Fig. 12.14 find out the area of shaded part.

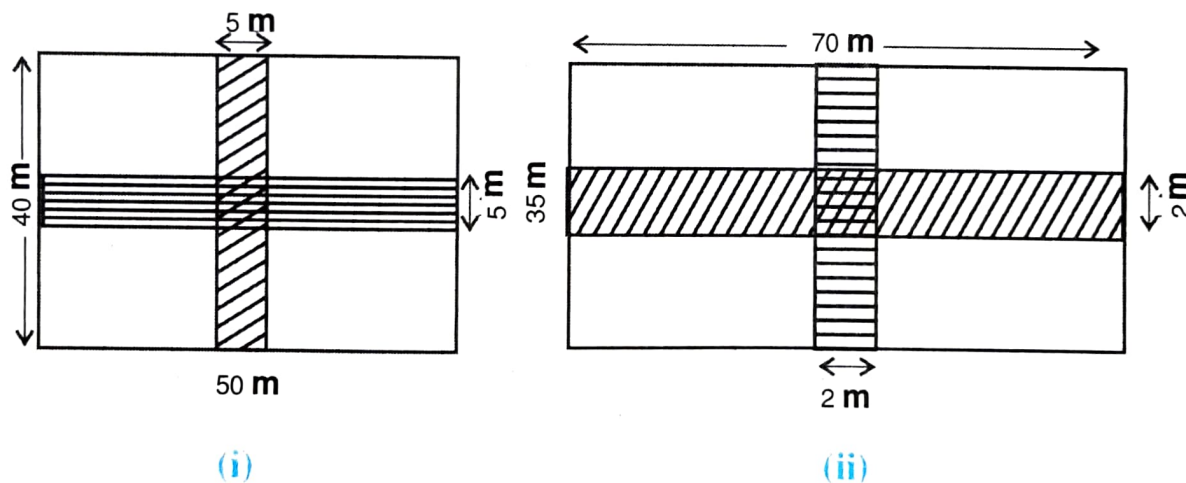


Fig. 12.14

2. The length and breadth of a rectangular lawn is 6m and 5m respectively. In middle of this there are situated two paths of 2m breadth which intersected to each other at right angle. One path is parallel to length and other is parallel to breadth. Find out the expenditure for laying concrete.

3. In figure 12.15, find area of shaded path.

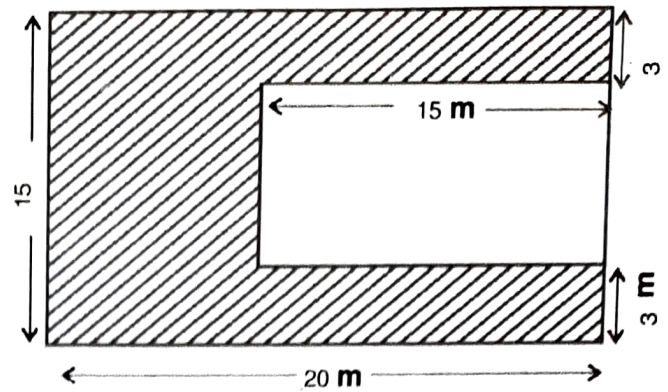


Fig. 12.15

4. In Fig. 12.16, find area of that part which is not shaded.

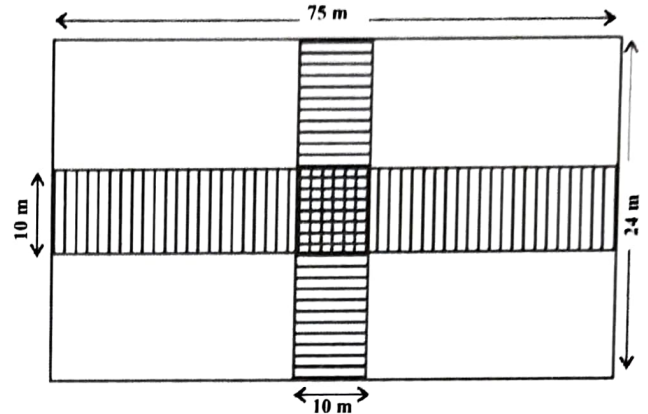


Fig. 12.16

5. In fig. 12.17, it is given a map of Government building. In this figure road has been seen by dotted part. Breadth of road is 2 m.

- Find the area of road.
- What will be expenditure for laying bricks at rate of ₹ 45 per square meter.

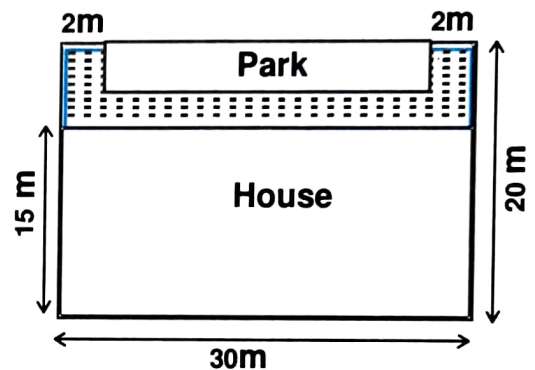


Fig. 12.17

6. Length and breadth of Guava orchard is 180 m and 120 m respectively. In middle of orchard there are two roads of 3m breadth intersecting perpendicular to each other. Find out expenditure for laying soil on the road at the rate of ₹12per m^2 .
7. The students of a school put a rally for cleaning. After sometime rally reached in a rectangular field, whose length is 40 m and breadth is 25 m. Student divided in three parts and according figure first group cleaned, the part ABFE and GCDH of two perpendicular road whose breadth is 5 m. Second

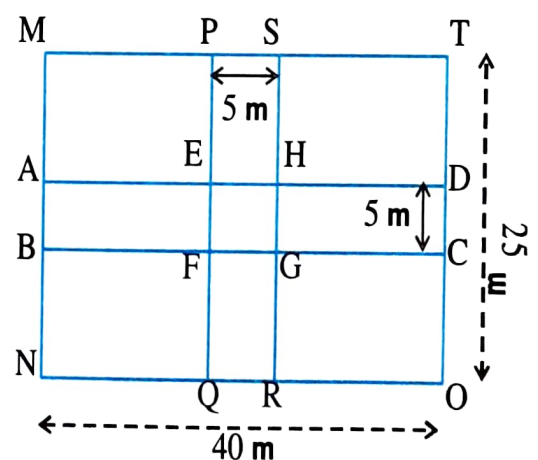


Fig. 12.18

group cleaned the part PEHS and FQRG. Third group cleaned the part EFGH. Find the area cleaned by every group.

12.5 Area of triangular region

We know that diagonal of rectangle(region) or square divide it in two congruent triangle. The area of every triangular region is half of the rectangular or squaral region in this. See fig. (i), (ii) of 12.18.

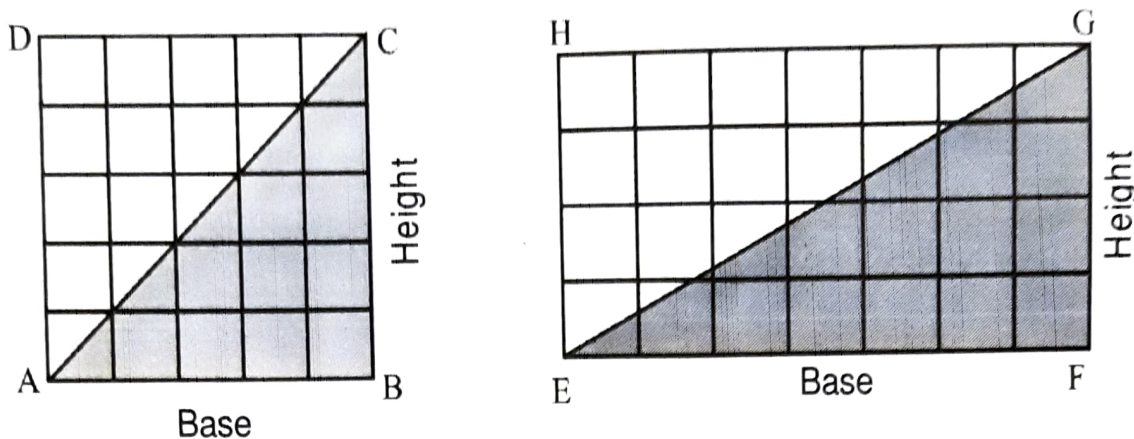


Fig. 12.18

$$\begin{aligned}
 \text{In Fig. (i) Area of triangular region ABC} &= \frac{1}{2} \text{ Area of square ABCD} \\
 &= \frac{1}{2} (AB \times BC) \\
 &= \frac{1}{2} (\text{Base} \times \text{height})
 \end{aligned}$$

$$\begin{aligned}
 \text{In Fig. (ii) Area of triangular region EFG} &= \frac{1}{2} \text{ Area of rectangle EFGH.} \\
 &= \frac{1}{2} (EF \times FG) \\
 &= \frac{1}{2} (\text{base} \times \text{height})
 \end{aligned}$$

See this also :

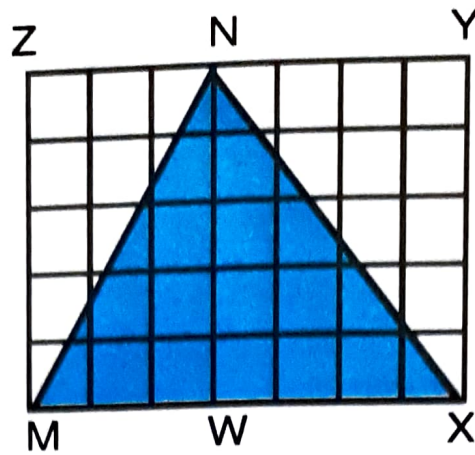


Fig. 12.19

In Fig. 12.19, $\triangle NMX$ is not right angle triangle. In this figure also, area of $\triangle NMX$ is half of the area of rectangle $MXYZ$. Examine this by counting the small square. For counting square in triangular region, that part which is half and more than half we count this as a whole square and that part which is less than half is not count.

$$\begin{aligned} \text{So, area of } \triangle NMX &= \frac{1}{2} \text{ MX} \cdot \text{YN} \\ &= \frac{1}{2} \text{ MX} \cdot \text{NW} \\ &= \frac{1}{2} \text{ base} \times \text{height} \end{aligned}$$

So,

$$1. \text{ Area of triangular region} = \frac{1}{2} \text{ Base} \times \text{corresponding height}$$

$$2. \text{ Base of triangle} = \frac{2 \times \text{Area of triangular region}}{\text{Corresponding height}}$$

$$3. \text{ Height of triangle} = \frac{2 \times \text{Area of triangular region}}{\text{Corresponding base}}$$

Note : Height of triangle is corresponding to base. Base is a side of triangle and corresponding height is a perpendicular which is drawn from the vertex to the base.

Example 9. The base of a triangle is 5 cm. and corresponding height is 6 cm. Find the area of region closed by triangle.

Solution : Base triangle = 5 cm.

Corresponding height = 6 cm.

So, Area of triangle = $\frac{1}{2} \times \text{Base} \times \text{corresponding height}$

$$= \frac{1}{2} \times 5 \times 6 \text{ cm}^2.$$

$$= 15 \text{ cm}^2$$

Example 10. Area of triangular region is 45 cm^2 and base is 15 cm. Find corresponding height of this triangle.

Solution : Area of triangular region = 45 cm^2

Base of triangle = 15 cm.

Height of triangle = $\frac{2 \times \text{Area}}{\text{Corresponding base}}$

$$= \frac{2 \times 45 \text{ cm}^2}{15 \text{ cm}}$$

$$= 6 \text{ cm}.$$

Example 11. In Fig. 12.20 There is right angle triangle ABC in which AB = 8 cm and AC = 6 cm. Find the area of triangle closed by right angle triangle ABC.

Solution : In $\triangle ABC$, $\angle A = 90^\circ$

So AC is a height of triangle.

Base = 8 cm, height = 6 cm.

So, Area of region closed by $\triangle ABC$

$$= \frac{1}{2} \times \text{base} \times \text{height}$$

$$= \frac{1}{2} \times 6 \times 8 \text{ cm}^2$$

$$= 24 \text{ cm}^2$$

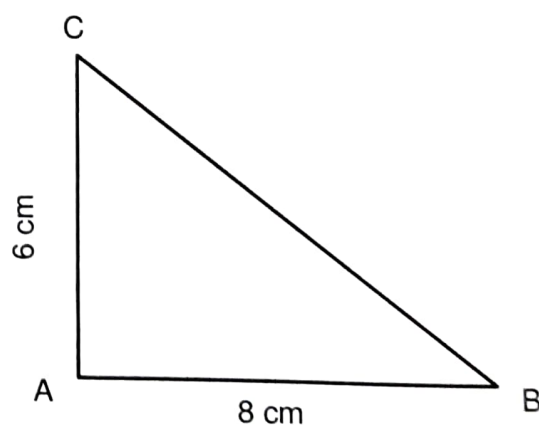


Fig. 12.20

Exercise 12 (d)

1. Fill in the blanks in following table :

S.N.	Base of Triangle	Height of Triangle	Area of Triangle
(i)	4.2 cm	2.1 cm	.....
(ii)	10 cm	8 cm	.....
(iii)	6.4 cm	.....	12.8 cm^2
(iv)	12 cm	.....	36 cm^2
(v)	.....	4 cm	12 cm^2
(vi)	.....	10.5 cm	42 cm^2
(vii)	x cm	2x cm	cm^2

2. Area of a triangular region is 48 cm^2 . If the height be 8 cm, then find out base of triangle.
3. Base of triangle is 5 cm. If height of triangle is double of base, find out the area of triangle.
4. Find the area of following triangular region in square metre, when given his base and corresponding height.
 - (i) Base = 15 cm, height = 8 cm.
 - (ii) Base = 7.5 cm, height = 4 cm
 - (iii) Base = 1.5 m, height = 0.8 m.
 - (iv) Base 32 cm, height = 105 cm.
5. Find out area of the region surrounded by triangles.

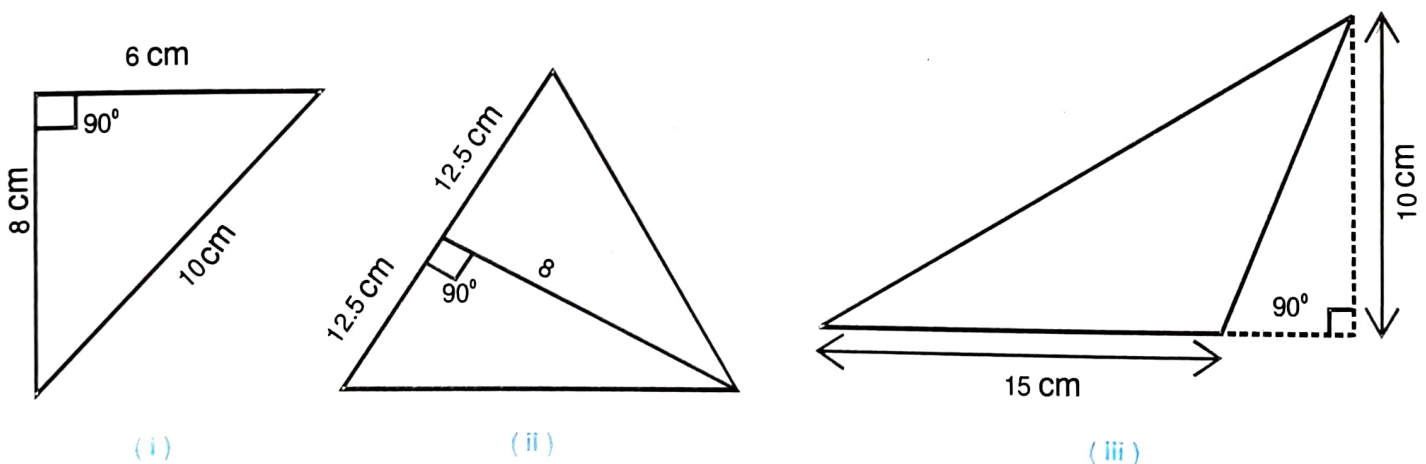


Fig. 12.21

6. At the edge of a road there is a triangular indicator board on which it is written “School ahead”. If the side of indicator board is 60 cm, 80 cm, and 100 cm. respectively, then find out its area.

12.6 Area of a region like parallelogram

See these :

Activities : On a cardboard make a parallelogram, from the one vertex. Draw a perpendicular AL on side BC. Thus we will found Right angle triangle ALB. See fig. 12.22 Cut the Δ ALB.

Join the Δ ALB, with rest part of parallelogram as side AB, meet with side DC. Like this make rectangle ALLD. See fig. 12.23.

Is the area of fig. 12.22 (parallelogram) is equal to the area of rectangular region showing fig. 12.23.

We see that the area of both quadrilateral are same.

So, Area of parallelogram ABCD = Area of rectangle ALLD
 = Length $\times$ Breadth
 = AD $\times$ DL
 = BC $\times$ AL (AD = BC)

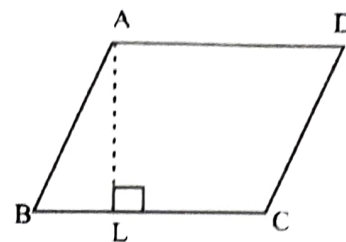


Fig. 12.22

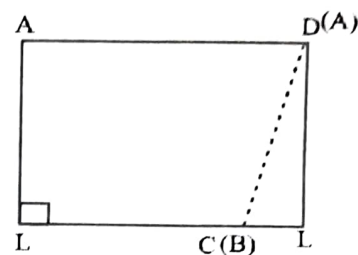


Fig. 12.23

So,

Area of region enclosed by parallelogram = One side of parallelogram $\times$ perpendicular drawn from the opposite vertex.

See this also :

In the following figure perpendicular AL and AM are drawn from vertex A of parallelogram ABCD on side BC and CD respectively.

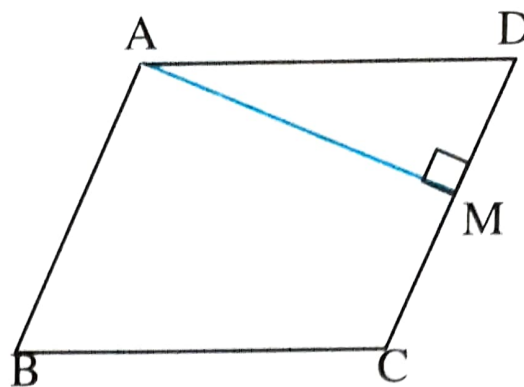
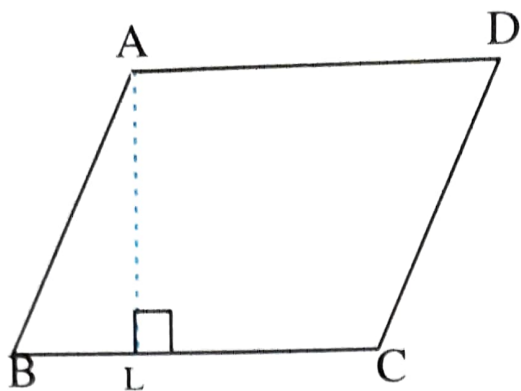


Fig. 12.24

In the following fig. perpendicular PN is drawn from point P on side SR, and perpendicular PK is drawn on one side RQ, which meet the RS at point N on increasing and PK at point K on increasing RQ.

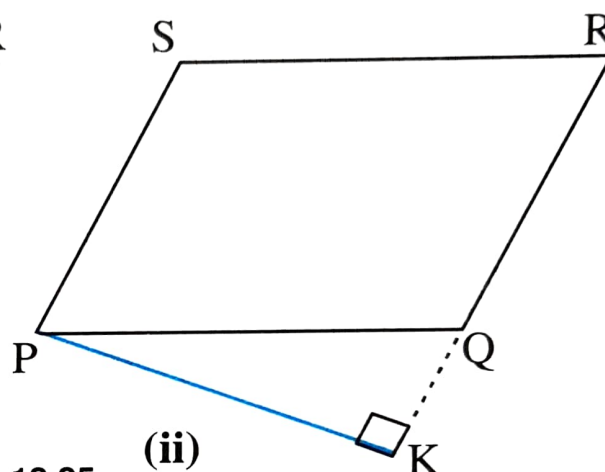
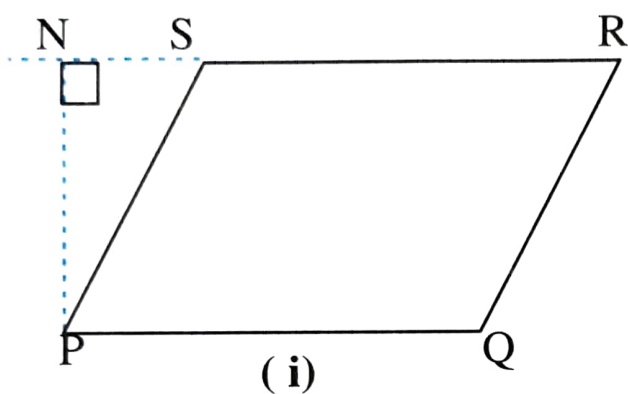


Fig. 12.25

We see for drawing perpendicular from the vertex we may have to increase opposite side.

The side at which perpendicular is drawn in parallelogram is called base and perpendicular on base is called corresponding height.

In Fig. 12.24 (i) BC is base and AL is corresponding height.

In Fig. 12.24 (ii) CD is base and AM is corresponding height.

In Fig. 12.25 (i) Base is SR and PN is corresponding height.

In Fig. 12.25 (ii) QR is base and PK is corresponding height.

$$\text{Area of parallelogram} = \text{Base} \times \text{Height}$$

$$\text{Base of Parallelogram} = \frac{\text{Area of Parallelogram}}{\text{Height}}$$

$$\text{Height of parallelogram} = \frac{\text{Area of Parallelogram}}{\text{Base}}$$

Example 12. In the following (i) and (ii) find out the area enclosed by parallelogram.

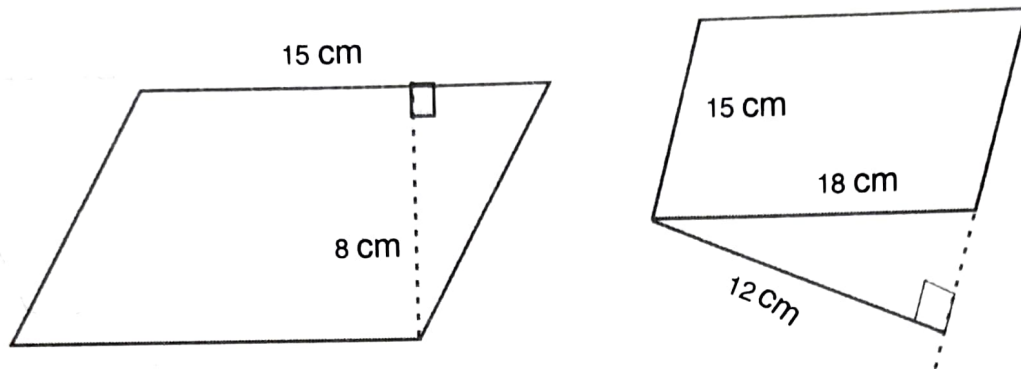


Fig. 12.26

Solution : Area of region enclosed by parallelogram = Base $\times$ Height
 $= 15 \text{ cm} \times 8 \text{ cm}$
 $= 120 \text{ cm}^2$

Area of region enclosed by parallelogram
 $= \text{base} \times \text{height}$
 $= 15 \text{ cm} \times 12 \text{ cm}$
 $= 180 \text{ cm}^2$

Example 13. Area of a parallelogram is 32 cm^2 . and measurement of base is 8 cm. Find out distance between the parallel side.

Solution : Here area of parallelogram $= 32 \text{ cm}^2$
 Base of parallelogram $= 8 \text{ cm}.$

In the question we have to find the distance between parallel lines (height).

$$\begin{aligned} \text{Height} &= \frac{\text{Area of Parallelogram}}{\text{Base}} \\ &= \frac{32 \text{ cm}^2}{8 \text{ cm}} \end{aligned}$$

So, height of parallelogram i.e., distance between two side $= 4 \text{ cm}.$

Exercise 12 (e)

1. Find out the area of every parallelogram whose measurement is given in the following table :

	(i)	(ii)	(iii)	(iv)	(v)	(vi)
Base	8 cm	2.8 cm	12 mm	6.5 cm	1m 5 cm	4.2 Decimeter
Height	3 cm	5 cm	8.7 cm	4.8 cm	45 cm	25 cm

2. Find out the area of following region bounded by parallelogram ;

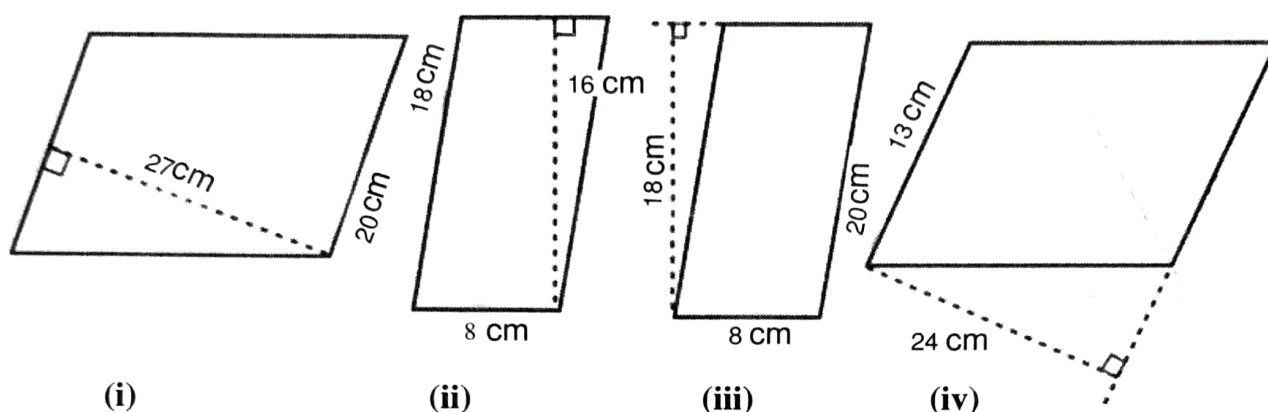


Fig. 12.27

3. Find out the height of that parallelogram by which area is 2.25 m^2 and base is 25 decimeter.
4. There is field of parallelogram shape. Its base is 15 decameter and height is 8 decametre. Find out expenditure for irrigation at the rate of ₹ 5 per metre².
5. In fig. 12.28, ABCD is parallelogram.
 $CF \perp AB$ and $BG \perp AD$.
- If $AB = 16 \text{ cm}$, $AD = 12 \text{ cm}$ and $CF = 10 \text{ cm}$ then find out BG .
 - If $AD = 10 \text{ cm}$, $CF = 8 \text{ cm}$ and $BG = 12 \text{ cm}$ then find out AB .

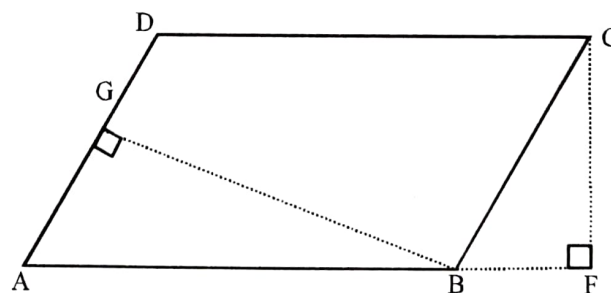


Fig. 12.28

12.7 Area of region like Rhombus :

We know that,

- Four sides of Rhombus are equal.
- The diagonals of Rhombus bisect each other at right angle.

Are four triangle made by diagonals of Rhombus congruent ?

To understand this make a Rhombus on a paper draw both diagonal of this. Cut out Rhombus. It has been shown in fig. 12.29.

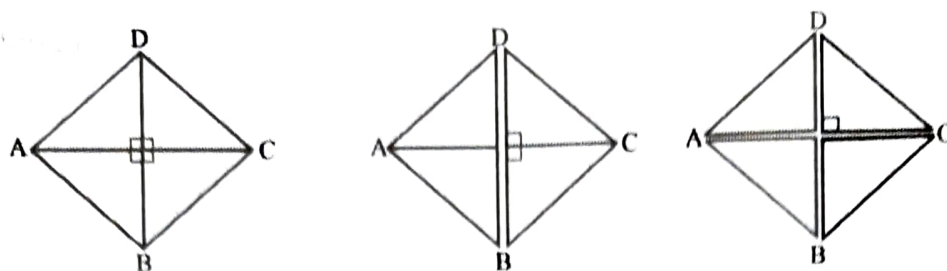


Fig. 12.29

Now fold this in the direction of diagonal BD and AC. Cut out the triangles with the help of scissor along with crease. We see that four triangles overlap completely to each other.

So,

Four triangles made by diagonals in Rhombus are congruent.

Again,

Area of Rhombus = $4 \times$ Area enclosed by Right angle triangle made by diagonal on cutting.

See these also :

See Rhombus PQRS in fig. 12.30. PR and QS are diagonals of Rhombus PQRS, which bisect at point O to each other. and divide these diagonal in four congruent triangles to Rhombus.

Area of Region closed by rhombus

$$= 4 \times \text{area closed by } \triangle SOR$$

$$= 4 \times \frac{1}{2} \times OR \times OS$$

$$= 4 \times \frac{1}{2} \times \frac{1}{2} PR \times \frac{1}{2} SQ$$

$$= \frac{1}{2} PR \times SQ$$

$$= \frac{1}{2} \text{ diagonal PR} \times \text{diagonal SQ}$$

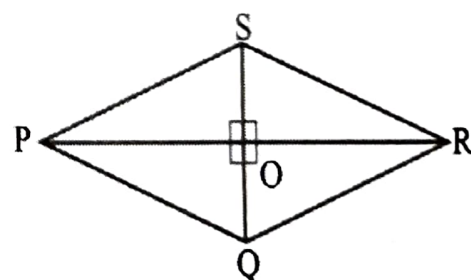


Fig. 12.30

So area of Rhombus = $\frac{1}{2}$ product of diagonals

Example 14. Length of the diagonal of Rhombus are 10 cm. and 7 cm. Find out the area of region of closed by rhombus.

Solution : Here given one diagonal = 10 cm.
 Second diagonal = 7 cm.
 Area of region closed by Rhombus = $\frac{1}{2} \times$ product of diagonal
 = $\frac{1}{2} \times 10 \text{ cm} \times 7 \text{ cm}$
 = 35 cm².

Exercise 12 (f)

1. In the following table there are given measurement related to Rhombus. Fill in the blanks on your exercise book.

S.N.	First diagonal	Second diagonal	Area
(i)	8 cm	10 cm	.....
(ii)	12 cm	.....	240 cm ²
(iii)	.....	6 cm	9 cm ²
(iv)	8.4 cm	6 cm	.....

2. In following fig. 12.31 there is given area of region enclosed by rhombus ABCD is 24 cm² and OD = 3 cm.

Find out :

- (i) Length of diagonal BD.
 (ii) Length of diagonal AC

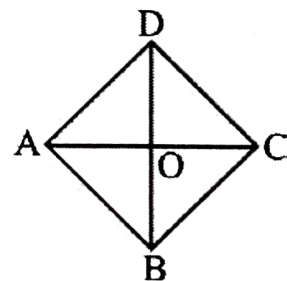


Fig. 12.31

3. Area of Nelima's plot like Rhombus is 80 m^2 , if the length of one diagonal is 16 m, then find out the length of the other diagonal.
4. On the basis of measure of fig. 12.32. Find out the area of region enclosed by rhombus.
5. There is grass for chewing 20 cows in a field in the shape of a rhombus. If every side of this field is 25 m and one diagonal is 30 m, then how many area will get every cow for chewing.

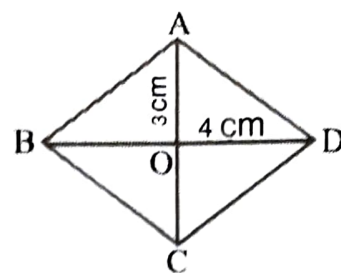


Fig. 12.32

12.8 Total Surface area of Cube and Cuboid :

Do this :

Take a match box. Open this box from top. In fig. 12.33 it has been shown 6 faces.

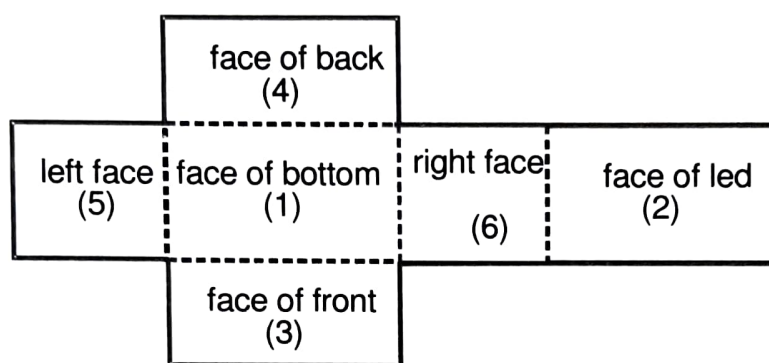


Fig. 12.33

It is clear that face of bottom (1) is congruent to face of lid (2). Similarly face of front (3) is congruent to face of back (4) and left face is congruent to right (6).

Try it :

Open the box of chalk and show that there are 6 rectangular face in this. There are total 6 faces in match box or Chalkbox. The sum of area of all these faces are called total surface area of this.

12.8.1. Cuboid

See fig. 12.34. This is a fig. of cuboid. At any plane it is not possible to make a solid figure. But we can make its abstract figure and can show it's related part.

Thus we see that in cuboid.

- (i) There are eight vertex.
- (ii) There are twelve edges.
- (iii) There are six faces and every faces are rectangular.
- (iv) Top face and bottom face are one pair of opposite faces.
- (v) Left and right faces are second pair of opposite sides.
- (vi) Front and back faces are third pair of opposite sides.

In figure ABCD is top face and EFGH is bottom face. ADEH and CBGF are left and right faces simultaneously. ABGH and DCFE are back and front faces.

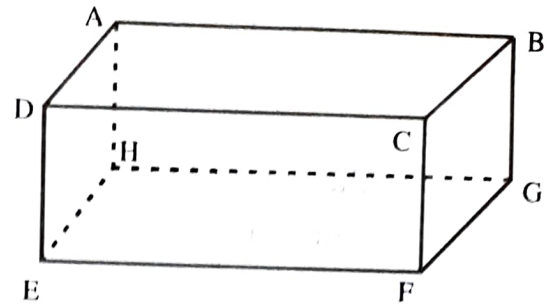


Fig. 12.34

12.8.2. Total Surface area of Cuboid :

We have seen that in the market so many goods are sold in pack of tin sheet or box of thick paper. In this packing, some packing are like cuboid. Box of steel, Almirah etc. are also like cuboid. For constructor it is necessary that he know that how many tin sheet, thick paper will required for construction. To know this it is necessary to find out the total surface area of this.

See this :

See the following cuboid, length of this is l cm, breadth is b cm. and height is h cm. Find out the total surface area of s.

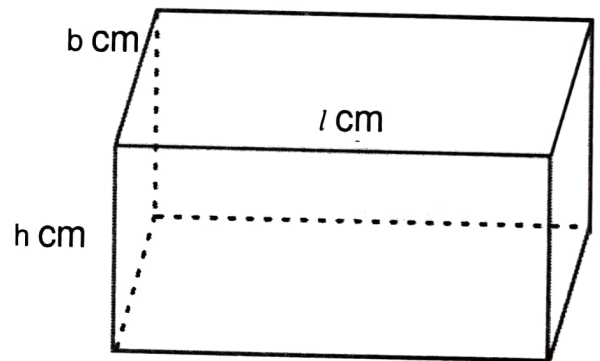


Fig. 12.35

Since we know that the total surface area of cuboid is sum of area of six faces.

$$\begin{aligned} \text{So, Sum of area of up and down faces} &= (l \times b + l \times b) \text{ cm}^2 \\ &= 2lb \text{ cm}^2 \end{aligned}$$

$$\begin{aligned} \text{Sum of area of left and right faces} &= (b \times h + b \times h) \text{ cm}^2 \\ &= 2bh \text{ cm}^2 \end{aligned}$$

Sum of area of front and back face	$= (h \times l + h \times l) \text{ cm}^2$ $= 2hl \text{ cm}^2$
Total surface of area of the cuboid	$= \text{Sum of areas of all the faces of cuboid}$ $= (2lb + 2bh + 2hl) \text{ cm}^2$ $= 2 (lb + bh + hl) \text{ cm}^2$

So,

Total Surface area of cuboid	$= 2 (\text{Length} \times \text{Breadth} + \text{breadth} \times \text{height} + \text{length} \times \text{height}) \text{ cm}^2$ $= 2 (lb + bh + hl) \text{ cm}^2$
-------------------------------------	--

Example 15. Find out total surface area of that cuboid whose length be 10 cm. breadth be 8 cm and height be 5 cm.

Solution : Given that $l = 10 \text{ cm}$, $b = 8 \text{ cm}$, $h = 5 \text{ cm}$.

So, Total surface area of cuboid

$$\begin{aligned}
 &= 2 (lb + bh + hl) \\
 &= 2 (10 \times 8 + 8 \times 5 + 5 \times 10) \text{ cm}^2 \\
 &= 2 (80 + 40 + 50) \text{ cm}^2 \\
 &= 340 \text{ cm}^2
 \end{aligned}$$

Example 16. The measurement of a container like cuboid is $50 \text{ cm} \times 40 \text{ cm} \times 30 \text{ cm}$. For making 20 container like this, how many price of tin will be required for buying. If price of 1 m^2 tin sheet is ₹ 100.

Solution : Given that $l = 50 \text{ cm}$, $b = 40 \text{ cm}$, $h = 30 \text{ cm}$.

Total surface area of one container

$$\begin{aligned}
 &= 2 (lb + bh + hl) \text{ cm}^2 \\
 &= 2 (50 \times 40 + 40 \times 30 + 30 \times 50) \text{ cm}^2 \\
 &= 2(2000 + 1200 + 1500) \text{ cm}^2 \\
 &= 2 \times 4700 \text{ cm}^2 \\
 &= 9400 \text{ cm}^2
 \end{aligned}$$

So total surface area of 20 container

$$\begin{aligned}
 &= 20 \times 9400 \text{ cm}^2 \\
 &= 188000 \text{ cm}^2 \\
 &= 18.8 \text{ m}^2
 \end{aligned}$$

So price of 18.8 m^2 tin (at the rate of ₹ 100 per m^2)

$$\begin{aligned}
 &= ₹ 18.8 \times 100 \\
 &= ₹ 1880
 \end{aligned}$$

So price will be ₹ 1880.

Area of four walls of a room

If the length, breadth and height are l cm, b cm and h cm simultaneously. Then we can see easily that the area of four walls of a room will be =

$$2 (lh + bh) = 2h (l + b)$$

$$\text{Area of four walls of a room} = 2 (l + b) h = 2 (\text{length} + \text{breadth}) \times \text{height}$$

Example 17. The length, breadth and height of a class room are 11 m, 8 m and 5 m. Find out the area of four walls of the room.

Solution : Length of room $l = 11$ m, breadth = 8 m, height = 5 m.

$$\begin{aligned}\text{So area of four walls} &= 2 (l + b) h \\ &= 2 \times (11 + 8) \times 5 \text{ m}^2 \\ &= 190 \text{ m}^2\end{aligned}$$

12.8.3. Total Surface area of Cube :

See this :

It is a figure of cube. If length, breadth and height are equal of a cuboid, then that cuboid is cube.

There are six faces in this also. Every face are of square shaped. Every face is equal in area.

Let one side of cube is a cm

$$\text{Area of one face} = \text{Side}^2 = a^2$$

$$\text{Total surface area of cube} = 6 \times \text{area of one face} = 6 a^2$$

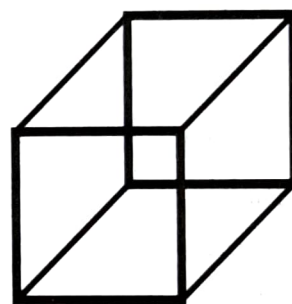


Fig. 12.36

So,

$$\text{Total surface area of a Cube} = 6 \times \text{Side}^2 = 6a^2$$

Example 18. Length of every edge of a cube is 4 cm. Then find out total surface area of the cube.

Solution : Given that $a = 4$ cm.

$$\begin{aligned}\text{Area of whole surface of cube} &= 6a^2 \\ &= 6 \times 4 \times 4 \\ &= 96 \text{ cm}^2\end{aligned}$$

Exercise 12 (g)

1. In the following table the length, breadth and height of cuboid are given. Find out total surface area of cuboid.

	(i)	(ii)	(iii)	(iv)	(v)	(vi)
l	5 cm	6 cm	10 cm	4 cm	5.5 cm	16 cm
b	4 cm	3 cm	8 cm	1.7 cm	4 cm	8 cm
h	3 cm	2 cm	5 cm	2.3 cm	10.5 cm	6 cm

2. Find out the total surface area of a cube from following measurements :
- | | |
|-------------------|------------------|
| (i) side 18 cm | (ii) side 8.8 cm |
| (iii) side 1.2 cm | (iv) side 110 cm |

3. Find out the total surface area of the given cuboid.

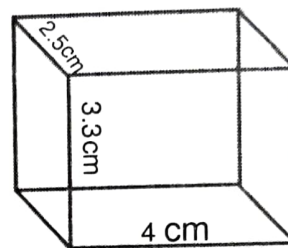


Fig. 12.37

4. The length, breadth and height of Abhishek's room are 4 m, 3.5 m and 3 m respectively. Find out the area of four walls of this room.
5. The length, breadth and height of a cubical box are 1 m, 30 cm. Find out total surface area of box.
6. The length, breadth and height of Rahim's room are 3.5 m, 3 m and 3 m respectively. Find out the expenditure for washing the 4 walls at the rate of ₹ 15 per m^2 .
7. One side of a cubical box is 10 cm. and length, breadth and height of cuboid is 12.5 cm, 10 cm and 8 cm. Whose area of 4 walls is more and how many ?
8. For packing the sweets, Pradeep sweet stall wants 200 box in the shape of a cuboid. Whose length is 25 cm breadth 20 cm and height 5 cm. What will be total price for making box at the rate of ₹ 40 per m^2 .

Ability Exercise - 12

1. Find out the area of the following shaded portion in following figure 12.38.

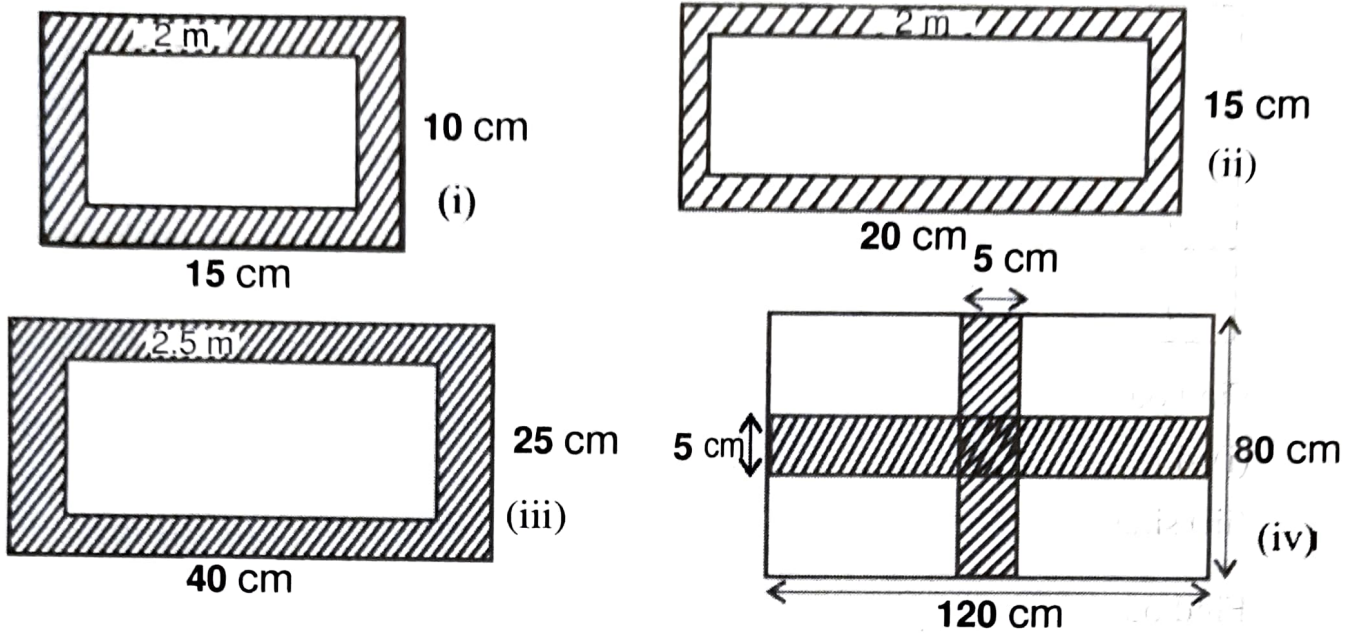


Fig. 12.38

2. There is a path of 1 m breadth inside around a square park. Length of park is 30 m. Find out the expenditure of growing grass in the rest part at the rate of ₹ 6 per m^2 .
3. Find out the area of that triangle whose base is 9.6 cm and height is 5 cm.
4. Find out the height of that triangle whose base is 15 cm. and area of triangle is 45 cm^2 .
5. In figure 12.39 find out the area of a region closed by quadrilateral ABCD. In which $AC = 48 \text{ cm}$, $BF = 10 \text{ cm}$ and $DE = 20 \text{ cm}$.

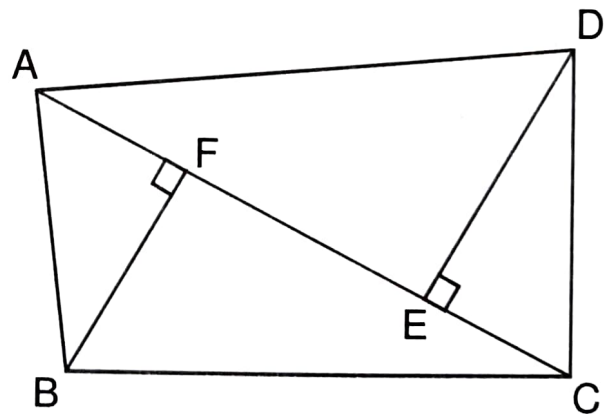


Fig. 12.39

6. Find out area of that parallelogram whose base is 7 cm and height is 4.3 cm.

7. Two cubes of side 12 cm are put together closed to each other according to fig. 12.40. Find out total surface area of this figure.

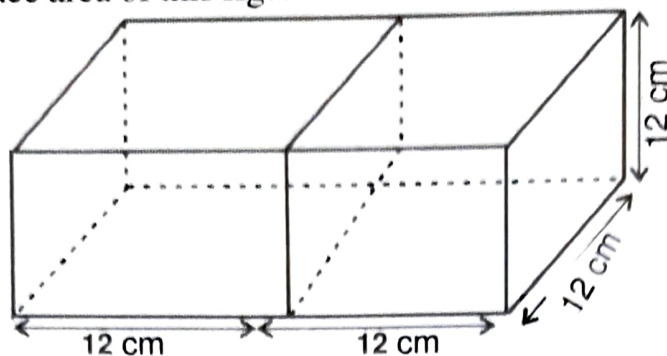


Fig. 12.40

We Learned in this unit

1. Perimeter of rectangle = $2(\text{length} + \text{breadth})$
2. Area of rectangle = $\text{length} \times \text{breadth}$
3. Perimeter of square = $4 \times \text{one side}$
4. Area of square = side^2
5. Area of triangle = $\frac{1}{2} \times \text{base} \times \text{corresponding height}$
6. Area of parallelogram = $\text{one side of parallelogram} \times \text{perpendicular drawn from opposite vertex on that side.}$
7. Four triangle in Rhombus are congruent made by diagonals.
8. Area of Rhombus = $\frac{1}{2} \times \text{product of diagonal}$
9. There are six faces in a cuboid, the sum of area of all the six faces is called total surface area.
10. If length of cuboid = l , breadth = b and height = h , then total surface area of cuboid = $2(lb + bh + hl)$.
11. Area of four walls of a room = $2(\text{length} + \text{breadth}) \times \text{height}$
12. Total Surface area of cube = $6 \times \text{side}^2 = 6 \times a^2 = 6a^2$

Bhaskaracharya Second (1114-1185)

Bhaskaracharya in algebra discussed use of zero. He did more work in Algebra about Sirds, Series, Simple equation and Quadratic equation. According to him square root of negative numbers is possible. In Lelawati he write more about, triangle, quadrilateral, and of circle and volume of sphere. He investigated approximate value of π = before, he used calculus in Jyotish before Newton.

ANSWERS

Exercise 12(a)

1. (i) 18 cm., (ii) 40 mm, (iii) 23 m, (iv) 14.4 m, 2. (i) 18 cm^2 , (ii) 100 mm^2 , (iii) 15 m^2 , (iv) 8 m^2 , 3. (i) 4 m, 18 m, (ii) 3 m, 22 m, (iii) 4 cm, 20 cm^2 , (iv) 210 cm, 6300 cm^2 , 4. 30 aere; 5. 2.64 hectare. 6. 40 m, 7. 144 cm^2 , 48 cm, 8. 750 ₹, 9. 4725.0 ₹.

Exercise 12(b)

1. 26 m, 16 m, 2. 31 m, 21 m, 3. (i) 200, (ii) 56, (iii) 144; 4. 96 m^2 , 5. 2500 m^2

Exercise 12(c)

1. (i) 425 m^2 , (ii) 206 m^2 , 2. ₹ 450; 3. 165 m^2 , 4. 910 m^2 , 5. (i) 72 m^2 , (ii) ₹ 3240, 6. ₹ 10692.0, 7. (i) 175 m^2 , 100 m^2 , 25 m^2 .

Exercise 12(d)

1. (i) 4.41 cm^2 , (ii) 40 cm^2 , (iii) 4 cm, (iv) 6 cm, (v) 6 cm, (vi) 8 cm, (vii) $x^2 \text{ cm}^2$, 2. 12 cm; 3. 25 cm^2 ; 4. (i) 0.006 m^2 , (ii) 0.0015 m^2 , (iii) 0.6 m^2 , (iv) 0.168 m^2 , 5. (i) 24 cm^2 , (ii) 100 cm^2 , (iii) 75 cm^2 , 6. 2400 cm^2 .

Exercise 12(e)

1. (i) 24 cm^2 , (ii) 14 cm^2 , (iii) 10.44 cm^2 , (iv) 31.20 cm^2 , (v) 0.4725 m^2 , (vi) 0.105 m^2 , 2. (i) 540 cm^2 , (ii) 128 cm^2 , (iii) 144 cm^2 , (iv) 312 cm^2 3. 90 cm, 4. ₹ 60,000; 5. (i) $13\frac{1}{3} \text{ cm}$, (i) 15 cm.

Exercise 12(f)

1. (i) 40 cm^2 , (ii) 40 cm, (iii) 6 cm, (iv) 25.2 cm^2 , 2. (i) 6 cm, (ii) 8 cm., 3. 10 m; 4. 24 cm^2 , 5. 30^2

Exercise 12(g)

1. (i) 94 cm^2 , (ii) 72 cm^2 , (iii) 340 cm^2 , (iv) 39.82 cm^2 , (v) 243.5 cm^2 , (vi) 544 cm^2 , 2. (i) 1944 cm^2 , (ii) 464.64 cm^2 , (iii) 8.64 cm^2 , (iv) 72600 cm^2 , 3. 62.90 m^2 , 4. 45 m^2 , 5. 101400 cm^2 , 6. ₹ 585; 7. Type of cuboid, 10 cm^2 , 8. ₹ 1160 m^2 .

Ability Exercise 12

1. (i) 84 m^2 , (ii) 124 m^2 , (iii) 300 m^2 , (iv) 975 m^2 ; 2. ₹ 4704; 3. 24 cm^2 , 4. 6 cm; 5. 720 cm^2 ; 6. 30.1 cm^2 ; 7. 1440 cm^2 .

