16

PERIMETER AND AREA

INTRODUCTION

In class VI, we have already learnt about perimeters of closed plane figures and areas of squares and rectangles. Perimeter of a closed plane figure is the length of its boundary and area is the measure of the part of plane or region enclosed by its boundary.

In this chapter, we shall review, revise and strengthen these and will learn about perimeter and area of some more closed plane figures.

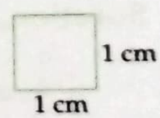
SQUARES AND RECTANGLES

The ***perimeter*** *of a closed plane figure is the length of its boundary.* **The unit of measurement of the perimeter is the same as that of length.**

The ***area*** *of a closed plane figure is the measure of the region (part of plane) 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 a square is 1cm, then the unit is called a square centimetre (written as cm^2) and if the side is 1 metre, then the unit is called a square metre (written as m^2) etc.



Perimeter and area of a square

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

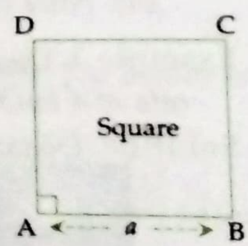
Thus, $P = 4a$, where P = perimeter and

a = length of a side of the square.

Area of a square = (length of a side)^2.

Thus, $A = a^2$, where A = area and

a = length of a side of the square.

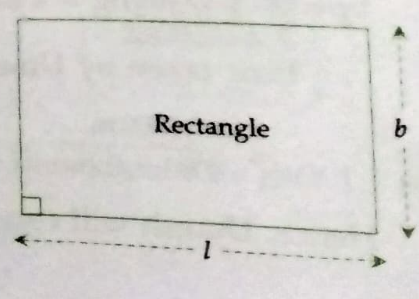


Perimeter and area of a rectangle

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

Thus, $P = 2(l + b)$, where P = perimeter, l = length and b = breadth of rectangle.

$\therefore\ l = \frac{P}{2} - b,\ b = \frac{P}{2} - l.$



Area of a rectangle = length × breadth.

Thus, $A = l \times b$, *where* A = *area,* l = *length and* b = *breadth of rectangle.*

$\therefore \quad l = \frac{A}{b}, \quad b = \frac{A}{l}.$

Note

The length and the breadth of a rectangle must be in the same units.

Conversion of units

Units of length	*Units of area*
1 cm = 10 mm	1 cm^2 = 10 mm × 10 mm = 100 mm^2
1 m = 100 cm	1 m^2 = 100 cm × 100 cm = 10000 cm^2
1 km = 1000 m	1 km^2 = 1000 m × 1000 m = 1000000 m^2
	1 hectare = 100 m × 100 m = 10000 m^2

In short, hectare is written as 'ha'.

Example 1. *Find the area of a rectangle whose length and breadth are 2.7 m and 85 cm.*

Solution. The length and the breadth must be expressed in the same units.

Length = 2.7 m and breadth = 85 cm = $\frac{85}{100}$ m = 0.85 m.

$\therefore$ Area of rectangle = length × breadth = (2.7 × 0.85) m^2 = 2.295 m^2.

Alternatively

Length = 2.7 m = (2.7 × 100) cm = 270 cm and breadth = 85 cm.

$\therefore$ Area of the rectangle = (270 × 85) cm^2 = 22950 cm^2.

Example 2. *The perimeter of a square is 26 cm. Find*

(i) the length of a side (ii) area of the square.

Solution. (*i*) Perimeter of a square = 4 (length of a side)

$\Rightarrow$ length of a side = $\frac{\text{perimeter of the square}}{4} = \frac{26}{4}$ cm = 6.5 cm.

(*ii*) Area of the square = (length of a side)^2 = (6.5 cm)^2 = 42.25 cm^2.

Example 3. *Umesh walks around a rectangular park with length 110 m and width 70 m at the rate of 4 km/hour. In how much time will he complete five rounds?*

Solution. Distance covered by Umesh in one round of the park

= perimeter of the park

= 2 (110 m + 70 m) = (2 × 180) m = 360 m.

$\therefore$ Distance covered in five rounds = (5 × 360) m = 1800 m

Speed of walking = 4 km/hour = (4 × 1000) m/hour = 4000 m/hour.

$\therefore$ Time taken by Umesh in covering 1800 m = $\frac{\text{distance}}{\text{speed}}$

$= \frac{1800\,\text{m}}{4000\,\text{m/hour}} = \frac{9}{20}$ hours $= \left(\frac{9}{20} \times 60\right)$ minutes = 27 minutes.

Hence, Umesh will complete five rounds in 27 minutes.

Example 4. *A wire is in the shape of a square of side 10 cm. If the wire is rebent into a rectangle of length 12 cm, find its breadth. Which shape encloses more area and by how much?*

Solution. Length of wire = perimeter of square = 4 × side
= 4 × 10 cm = 40 cm

As the wire is rebent into the shape of a rectangle,
perimeter of rectangle = length of wire = 40 cm.
Let the breadth of the rectangle be b cm.
Perimeter of rectangle = 2 (length + breadth)

$\Rightarrow$ 40 cm = 2 (12 + b) cm $\Rightarrow 40 = 2(12 + b)$

$\Rightarrow$ $20 = 12 + b \Rightarrow b = 20 - 12 \Rightarrow b = 8.$

$\therefore$ The breadth of rectangle = 8 cm

Area of square = 10 cm × 10 cm = 100 cm^2,
area of rectangle = 12 cm × 8 cm = 96 cm^2.

$\therefore$ Area of square – area of rectangle = (100 – 96) cm^2 = 4 cm^2.

Hence, square has more area by 4 cm^2.

Example 5. *The area of a square and a rectangle are equal. If the side of the square is 40 cm and the breadth of the rectangle is 25 cm, find the length of the rectangle. Also, find the perimeter of the rectangle.*

Solution. Area of a square = $(\text{side})^2$ = 40 cm × 40 cm = 1600 cm^2.

As the area of rectangle = area of square

$\Rightarrow$ area of rectangle = 1600 cm^2

Let the length of the rectangle be l cm.

Area of rectangle = length × breadth

$\Rightarrow$ l cm × 25 cm = 1600 $cm^2 \Rightarrow 25\,l = 1600$

$\Rightarrow$ $l = \dfrac{1600}{25} \Rightarrow l = 64.$

$\therefore$ The length of rectangle = 64 cm.

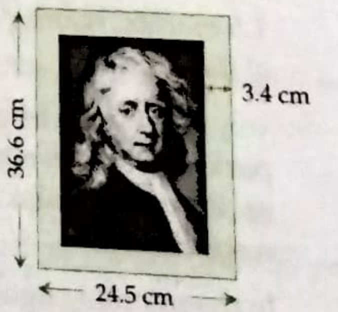
Perimeter of rectangle = 2 (length + breadth)
= 2 (64 cm + 25 cm) = (2 × 89) cm = 178 cm.

Example 6. *The rectangular frame of a picture is 24.5 cm wide and 36.6 cm high. The border is 3.4 cm wide. Calculate the perimeter of the picture.*

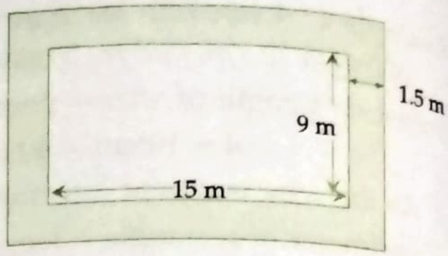
Solution. Width of picture = 24.5 cm – (3.4 cm + 3.4 cm)
= 24.5 cm – 6.8 cm = 17.7 cm

Height of picture = 36.6 cm – (3.4 cm + 3.4 cm)
= 36.6 cm – 6.8 cm = 29.8 cm.

$\therefore$ Perimeter of picture = 2 (width + height)
= 2 (17.7 cm + 29.8 cm)
= (2 × 47.5) cm = 95 cm.



Example 7. *A rectangular lawn is 15 m long and 9 m wide. It is surrounded by a path 1.5 m wide all around. Find the area of the path.*



Solution. In the adjoining figure, the shaded portion shows the path.

Area of the lawn = (15×9) m^2 = 135 m^2.

The length of the outer rectangle

= 15 m + 1.5 m + 1.5 m

= 18 m

and the breadth of the outer rectangle = 9 m + 1.5 m + 1.5 m = 12 m.

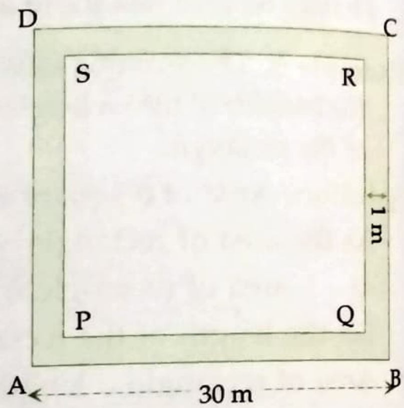
∴ Total area of the lawn and the path = (18×12) m^2 = 216 m^2.

∴ The area of the path = 216 m^2 – 135 m^2 = 81 m^2.

Example 8. *A path 1 metre wide is built along the border and inside a square garden of side 30 m. Find:*

(i) the area of the path.

(ii) the cost of planting grass in the remaining portion of the garden at the rate of ₹40 per m^2.



Solution. (*i*) Let ABCD be a square garden of side 30 m. A path 1 metre wide is built along the border inside.

In the adjoining figure, the shaded portion shows the path.

Note that PQRS is a square of side

= 30 m – 1 m – 1 m = 28 m.

Area of square ABCD = (side)^2

= 30 m × 30 m = 900 m^2,

area of square PQRS = (side)^2 = 28 m × 28 m

= 784 m^2.

∴ Area of path = 900 m^2 – 784 m^2 = 116 m^2

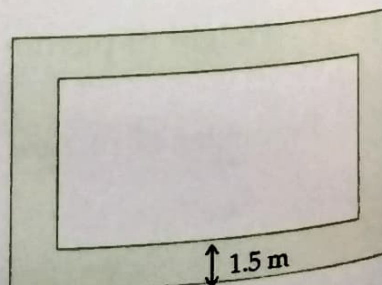
(*ii*) Area of the remaining portion of the garden = area of square PQRS = 784 m^2.

∴ Cost of planting grass in the remaining portion of the garden

= ₹(40 × 784)

= ₹31360.

Example 9. *The length and the breadth of a rectangular park are in the ratio 7 : 5. A path 1.5 m wide, running all around outside the park, has an area of 513 m^2. Find the perimeter of the park.*



Solution. Since the length and the breadth of the rectangular park are in the ratio 7 : 5, let the length and breadth of the rectangular park be $7x$ metres and $5x$ metres respectively.

In the adjoining figure, the shaded portion shows the path.

Area of the rectangular park = $(7x \times 5x)$ m^2 = $35x^2$ m^2

Length of the outer rectangle = $(7x + 1.5 + 1.5)$ m = $(7x + 3)$ m,

breadth of the outer rectangle = $(5x + 1.5 + 1.5)$ m = $(5x + 3)$ m.

Total area of the park and the path $= ((7x + 3) \times (5x + 3))\ m^2$

$= (35x^2 + 21x + 15x + 9)\ m^2$

$= (35x^2 + 36x + 9)\ m^2$.

$\therefore$ The area of the path $= ((35x^2 + 36x + 9) - 35x^2)\ m^2$

$= (36x + 9)\ m^2$

According to given, $36x + 9 = 513$

$\Rightarrow 36x = 504 \Rightarrow x = \frac{504}{36} \Rightarrow x = 14$.

$\therefore$ Length of park $= (7 \times 14)$ m $= 98$ m and

breadth of park $= (5 \times 14)$ m $= 70$ m.

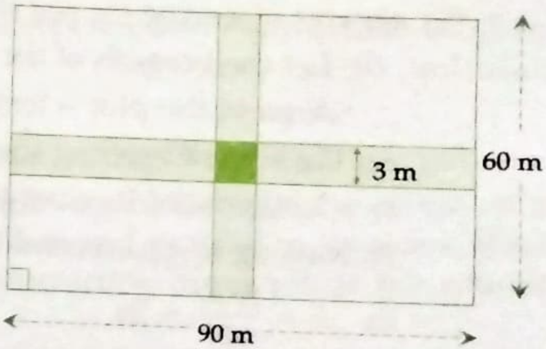
$\therefore$ Perimeter of the park $= 2(l + b) = 2(98 + 70)$ m

$= (2 \times 168)$ m $= 336$ m

Example 10. *Through a rectangular field of length 90 m and breadth 60 m, two cross roads are constructed which are parallel to the sides and cut each other at right angles through the centre of the field. If the width of each road is 3 m, find*

(i) *the area covered by the roads.*

(ii) *the cost of constructing the roads at the rate of ₹ 110 per m².*



Solution. (i) The area covered by the roads is shown shaded in the adjoining diagram.

Area of the shaded portion parallel to the length $= (90 \times 3)\ m^2 = 270\ m^2$.

Area of the shaded portion parallel to the breadth $= (60 \times 3)\ m^2 = 180\ m^2$.

Area of the dark shaded portion $= (3 \times 3)\ m^2 = 9\ m^2$.

$\therefore$ The area covered by the cross roads = area of shaded portion

$= 270\ m^2 + 180\ m^2 - 9\ m^2 = 441\ m^2$

Note that we subtract 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) Given, the cost of constructing the roads is at the rate of ₹ 110 per m².

$\therefore$ Total cost of constructing the roads = ₹ (110×441) = ₹ 48510.

Example 11. *The perimeter of the floor of a rectangular room is 17 m and its length is 5 m. Find*

(i) *the breadth of the room.*

(ii) *the floor area of the room.*

(iii) *the cost of flooring the room with square tiles of side 25 cm at the rate of ₹ 850 per hundred tiles.*

Solution. (i) Let the breadth of the room be b metres.

Perimeter of the floor of the room = 2 (length + breadth).

$\therefore \quad 17 = 2(5 + b) \Rightarrow 17 = 10 + 2b$

$\Rightarrow$ $2b = 17 - 10 = 7 \Rightarrow b = 3.5$

$\therefore$ The breadth of the room = 3.5 m.

(ii) Floor area of the room = $(5 \times 3.5)\ m^2 = 17.5\ m^2$.

(iii) Area of one tile = $(25 \times 25)\ cm^2 = 625\ cm^2$.

Area of the floor of the room = $17.5\ m^2 = (17.5 \times 10000)\ cm^2 = 175000\ cm^2$

$\therefore$ The number of tiles required to cover the floor of the room

$$= \frac{\text{area of the floor}}{\text{area of one tile}} = \frac{175000}{625} = 280.$$

As the cost of 100 tiles = ₹850,

$\therefore$ the cost of 280 tiles = ₹$\left(\frac{850}{100} \times 280\right)$ = ₹2380.

Hence, the cost of flooring the room with tiles = ₹2380.

Example 12. *A rectangular plot of land is 40 m long. The cost of leveling the plot at the rate of ₹8 per m^2 is ₹8320. Find*

(i) *the breadth of the plot.*

(ii) *the cost of fencing the plot at the rate of ₹27.5 per metre.*

Solution. (i) Let the breadth of the plot be b metres.

$\therefore$ Area of the plot = length × breadth = $(40 \times b)\ m^2 = 40b\ m^2$.

As the cost of leveling the plot is ₹8 per m^2,

$\therefore$ total cost of leveling the plot = ₹$(8 \times 40b)$ = ₹$320b$.

According to given condition, $320b = 8320$

$$\Rightarrow b = \frac{8320}{320} = 26.$$

$\therefore$ Breadth of plot = 26 m.

(ii) Perimeter of the plot = 2(length + breadth)

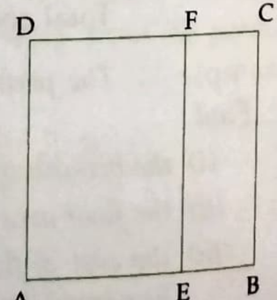
= 2(40 m + 26 m) = (2 × 66) m = 132 m.

Since the cost of fencing the plot is ₹27.5 per metre,

$\therefore$ total cost of fencing the plot = ₹(27.5 × 132) = ₹3630.

Exercise 16.1

1. ABCD is a square of side 24 cm. EF is parallel to BC and AE = 15 cm. By how much does
   (i) the perimeter of AEFD exceed the perimeter of EBCF?
   (ii) the area of AEFD exceed the area of EBCF?



2. Nagma runs around a rectangular park 180 m long and 120 m wide at the rate of 7.5 km/hour. In how much time will she complete five rounds?
3. The area of a rectangular plot is 540 m^2. If its length is 27 m, find its breadth and perimeter.

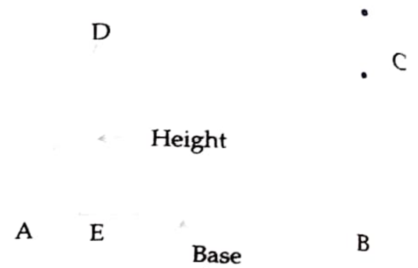
4. The perimeter of a rectangular field is 151 m. If its breadth is 32 m, find its length and area.
5. The area of a rectangular plot is 340 m^2 and its breadth is 17 m. Find the cost of surrounding the plot with a fence at ₹5.70 per metre.
6. The area of a square park is the same as that of a rectangular park. If the side of the square park is 60 m and the length of the rectangular park is 90 m, find the breadth of the rectangular park.
7. A wire is in the shape of a rectangle. Its length is 40 cm and breadth is 22 cm. If the same wire is rebent in the shape of a square, what will be the measure of each side? Also find which shape encloses more area and by how much?
8. A door of breadth 1m and height 2 m is fitted in a wall. The length of the wall is 4.5 m and the height is 3.6 m. Find the cost of white washing the wall, if the rate of white washing the wall is ₹20 per m^2.
9. A rectangular park is 45 m long and 30 m wide. A path 2.5 m wide is constructed outside the park. Find the area of the path.
10. A carpet of size 5 m × 2 m has 25 cm wide red border. The inner part of the carpet is blue in colour. Find the area of blue portion. What is the ratio of the areas of red portion to blue portion?
11. A *verandah* of width 2.25 m is constructed all along outside a room which is 5.5 m long and 4 m wide. Find:
    (*i*) the area of the *verandah*.
    (*ii*) the cost of cementing the floor of the *verandah* at the rate of ₹200 per m^2.
12. Two cross roads, each of width 5 m, run at right angles through the centre of a rectangular park of length 70 m and breadth 45 m and parallel to its sides. Find the area of the roads. Also find the cost of constructing the roads at the rate of ₹105 per m^2.
13. A rectangular room is 10 m long and 7.5 m wide. Find the cost of covering the floor with carpet 1.25 m wide at ₹250 per metre.
14. Find the cost of flooring a room 6.5 m by 5 m with square tiles of side 25 cm at the rate of ₹9.40 per tile.
15. The floor of a room is in the shape of a square of side 4.8 m. The floor is to be covered with square tiles of perimeter 1.2 m. Find the cost of covering the floor if each tile costs ₹27.
16. A rectangular plot of land is 50 m wide. The cost of fencing the plot at the rate of ₹18 per metre is ₹4680. Find
    (*i*) the length of the plot.
    (*ii*) the cost of leveling the plot at the rate of ₹7.6 per m^2.
17. The area of a rectangular plot is 460 m^2. If the length is 15% more than its breadth, find the perimeter of the plot.

AREA OF A PARALLELOGRAM

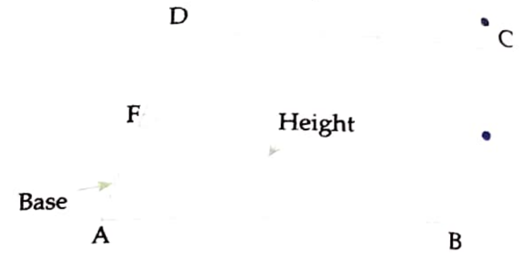
Base and height of a parallelogram

A parallelogram has two pairs of opposite sides which are equal and parallel. Any side can be taken as **base** of the parallelogram. The perpendicular dropped on that side from one of the opposite vertex is known as **(corresponding) height.**

In parallelogram ABCD, DE is perpendicular to side AB. Here, AB is the base and DE is the height of the parallelogram ABCD.



In parallelogram ABCD, BF is perpendicular to side AD. Here, AD is the base and BF is the height of the parallelogram ABCD.



Area of a parallelogram

To find the area of a parallelogram, we convert it into a rectangle of equal area. Let us learn it through an activity.

Activity 11

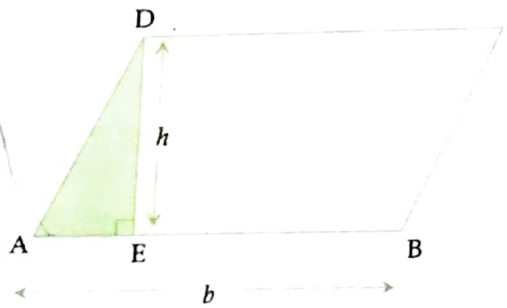
To find the area of a parallelogram

Materials required

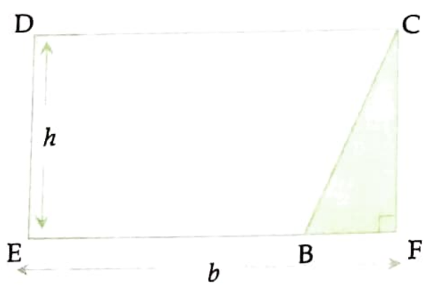
(*i*) Drawing sheet (*ii*) Geometry box (*iii*) Pair of scissors (*iv*) Fevistick/gum.

Steps

1. Draw any parallelogram ABCD of base b and height h on a drawing sheet.
2. From D, draw DE perpendicular to side AB.
3. Shade ΔDAE in dark colour and the remaining part of parallelogram ABCD *i.e.* the part DEBC in light colour as shown in fig. (*i*).
4. Cut off ΔDAE and paste it in the position CBF as shown in fig. (*ii*).



(*i*)



(*ii*)

Result

We observe that DEFC is a rectangle. Also we note that ΔDAE has been cut from one side of the figure and joined to the other side of the figure. So, the area enclosed by the figure remains the same.

$\therefore$ Area of parallelogram ABCD = area of rectangle DEFC = EF × DE = $b \times h$

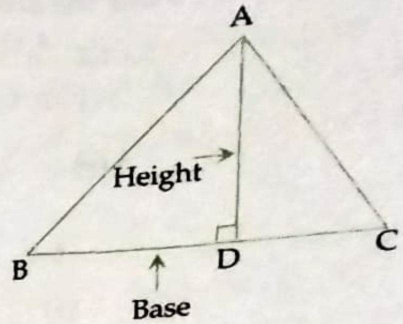
= base × height

Area of a parallelogram = base × height.

AREA OF A TRIANGLE

Base and height of a triangle

A triangle has three sides. Any side of a triangle can be taken as its base and the length of perpendicular (altitude) drawn from the opposite vertex to the base is called its (**corresponding**) **height**.



In the adjoining diagram, BC is the base of ΔABC. From A, draw AD perpendicular to BC, then the length of the line segment AD is the height of ΔABC.

Area of a triangle

Let us find the area of a triangle through an activity.

Activity 12

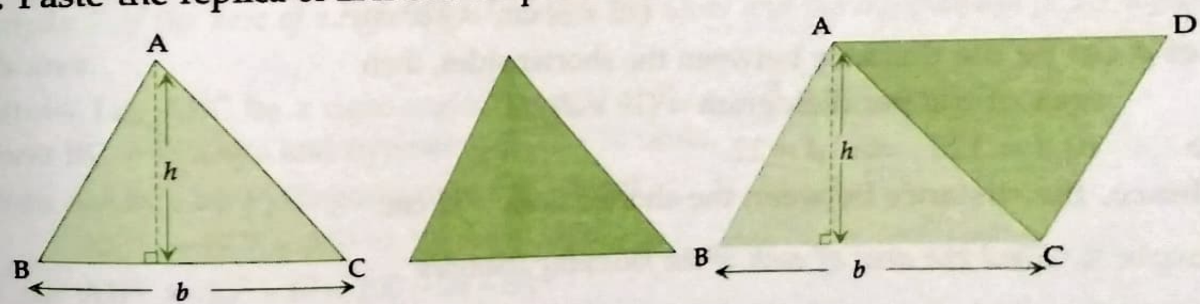
To find the area of a triangle

Materials required

(*i*) Drawing sheet (*ii*) Geometry box (*iii*) Pair of scissors (*iv*) Fevistick/gum.

Steps

1. Draw any triangle ABC of base *b* and height *h* on a drawing sheet and shade it in light colour as shown in fig. (*i*).
2. Make a replica (exact copy) of ΔABC from the drawing sheet and shade it in dark colour as shown in fig. (*ii*).
   Note that ΔABC and its replica are congruent triangles, so they have equal areas.
3. Paste the replica of ΔABC in the position ACD as shown in fig. (*iii*).



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

Result

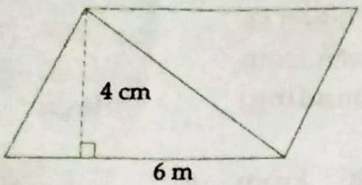
We observe that ABCD is a parallelogram. Also note that the area of parallelogram ABCD consists of area of ΔABC and area of its replica.

$\therefore$ Area of ΔABC $= \frac{1}{2}$ of area of parallelogram ABCD

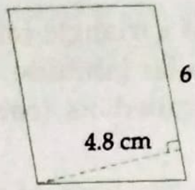
$= \frac{1}{2} \times b \times h = \frac{1}{2} \times$ base $\times$ height

Area of a triangle $= \frac{1}{2} \times$ ***base*** $\times$ ***height.***

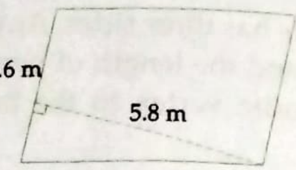
Example 1. *Find the area of each of the following parallelograms:*



(*i*)



(*ii*)



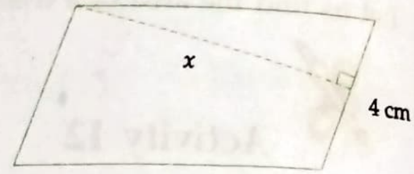
(*iii*)

Solution. (*i*) Area of the parallelogram = base × height = 6 cm × 4 cm = 24 cm^2.

(*ii*) Area of the parallelogram = 6 cm × 4.8 cm = 28.8 cm^2.

(*iii*) Area of the parallelogram = 3.6 m × 5.8 m = 20.88 m^2.

Example 2. *The area of the parallelogram (shown in the adjoining figure) is 24 cm^2. If the base is 4 cm, find its height 'x'.*

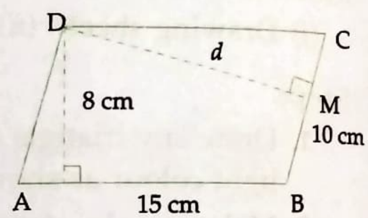


Solution. Area of a parallelogram = base × height

$\therefore$ $24 \text{ cm}^2 = 4 \text{ cm} \times x \Rightarrow x = \frac{24}{4} \text{ cm} = 6 \text{ cm}.$

Hence, the height of the parallelogram is 6 cm.

Example 3. *Two adjacent sides of a parallelogram are 15 cm and 10 cm. If the distance between the longer sides is 8 cm, find the area of the parallelogram. Also find the distance between the shorter sides.*



Solution. Taking 15 cm as the base of the parallelogram, its height is 8 cm.

Area of the parallelogram = base × height

= (15 × 8) cm^2 = 120 cm^2.

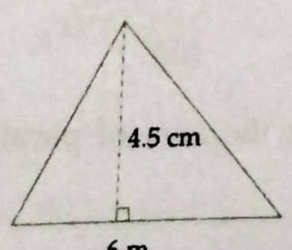
Let d cm be the distance between the shorter sides, then

area of the parallelogram = (10 × d) cm^2

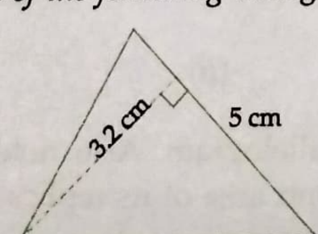
$\Rightarrow$ $10\,d = 120 \Rightarrow d = 12.$

Hence, the distance between the shorter sides = 12 cm.

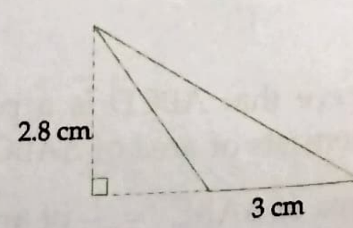
Example 4. *Find the area of each of the following triangles:*



(*i*)



(*ii*)



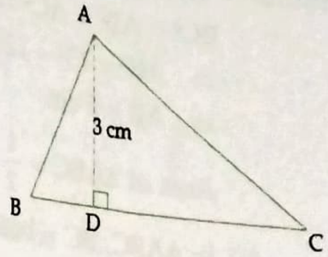
(*iii*)

Solution. (*i*) Area of the triangle = $\frac{1}{2}$ × base × height = $\frac{1}{2}$ × 6 cm × 4.5 cm = 13.5 cm^2.

(*ii*) Area of the triangle = $\frac{1}{2}$ × 5 cm × 3.2 cm = 8 cm^2.

(*iii*) Area of the triangle $= \frac{1}{2} \times 3 \text{ cm} \times 2.8 \text{ cm} = 4.2 \text{ cm}^2$.

Example 5. *The area of ΔABC (shown in the adjoining figure) is 18 cm². If the height AD is 3 cm, find the length of side BC.*



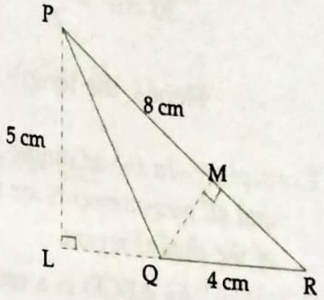
Solution. Area of a triangle $= \frac{1}{2} \times \text{base} \times \text{height}$

$\therefore \quad 18 \text{ cm}^2 = \frac{1}{2} \times BC \times 3 \text{ cm}$

$\Rightarrow \quad BC = \left(18 \times \frac{2}{3}\right) \text{ cm} = 12 \text{ cm}$

Hence, the length of side BC = 12 cm.

Example 6. *In ΔPQR (shown in the adjoining figure), PR = 8 cm, QR = 4 cm and PL = 5 cm. Find:*
(*i*) *the area of ΔPQR* (*ii*) *the length of QM.*



Solution. (*i*) Area of $\Delta PQR = \frac{1}{2} \times \text{base} \times \text{height}$

$= \frac{1}{2} \times 4 \text{ cm} \times 5 \text{ cm} = 10 \text{ cm}^2.$

(*ii*) In ΔPQR, PR = base = 8 cm and height = QM.

Area of $\Delta PQR = \frac{1}{2} \times PR \times QM$

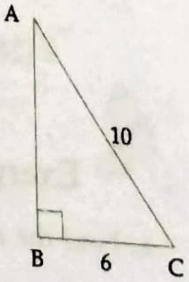
$\therefore \quad 10 \text{ cm}^2 = \frac{1}{2} \times 8 \text{ cm} \times QM$

$\Rightarrow \quad QM = \frac{10}{4} \text{ cm} = \frac{5}{2} \text{ cm} = 2.5 \text{ cm}.$

Hence, the length of QM = 2.5 cm.

Example 7. *If the base of a right-angled triangle is 6 units and the hypotenuse is 10 units, find its area.*

Solution. Let ABC be a right-angled triangle at B *i.e.* $\angle B = 90°$ and its base BC = 6 units and hypotenuse AC = 10 units.



From ΔABC, by Pythagoras property, we get

$AC^2 = BC^2 + AB^2 \Rightarrow 10^2 = 6^2 + AB^2$

$\Rightarrow AB^2 = 10^2 - 6^2 = 100 - 36 = 64$

$\Rightarrow AB = 8$ units.

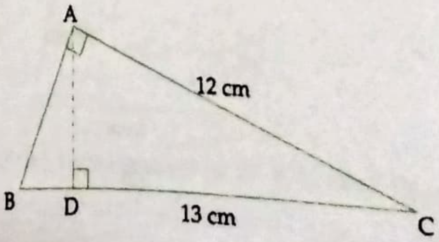
Area of $\Delta ABC = \frac{1}{2} \times \text{base} \times \text{height}$

$= \left(\frac{1}{2} \times 6 \times 8\right)$ sq. units = 24 sq. units.

Example 8. *In the adjoining diagram, ΔABC is right angled at A and AD is perpendicular to BC. If AC = 12 cm and BC = 13 cm, find:*

(*i*) *the area of ΔABC.*

(*ii*) *the length of altitude AD.*



Solution. (*i*) As ΔABC is right angled at A, by Pythagoras property,

$BC^2 = AB^2 + AC^2 \Rightarrow 13^2 = AB^2 + 12^2$

$\Rightarrow AB^2 = 13^2 - 12^2 = 169 - 144 = 25$

$\Rightarrow AB = 5$ cm

Area of $\Delta ABC = \frac{1}{2} \times \text{base} \times \text{height} = \frac{1}{2} \times 12 \text{ cm} \times 5 \text{ cm} = 30 \text{ cm}^2$.

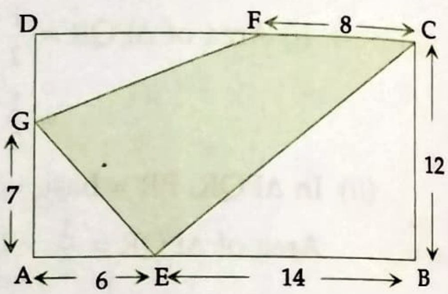
(*ii*) In ΔABC, BC = base = 13 cm and height = AD.

Area of $\Delta ABC = \frac{1}{2} \times \text{base} \times \text{height}$

$\therefore 30 \text{ cm}^2 = \frac{1}{2} \times 13 \text{ cm} \times AD \quad \Rightarrow AD = \frac{60}{13}$ cm.

Hence, the length of $AD = \frac{60}{13}$ cm.

Example 9. *In the adjoining figure, ABCD is a rectangle and all measurements are in centimetres. Find the area of the shaded region.*



Solution. As ABCD is a rectangle, AB = DC and AD = BC.

From figure, AB = AE + EB = 6 + 14 = 20,

DF = DC – FC = AB – 8 = 20 – 8 = 12,

GD = AD – AG = BC – 7 = 12 – 7 = 5.

$\therefore$ Area of the shaded region

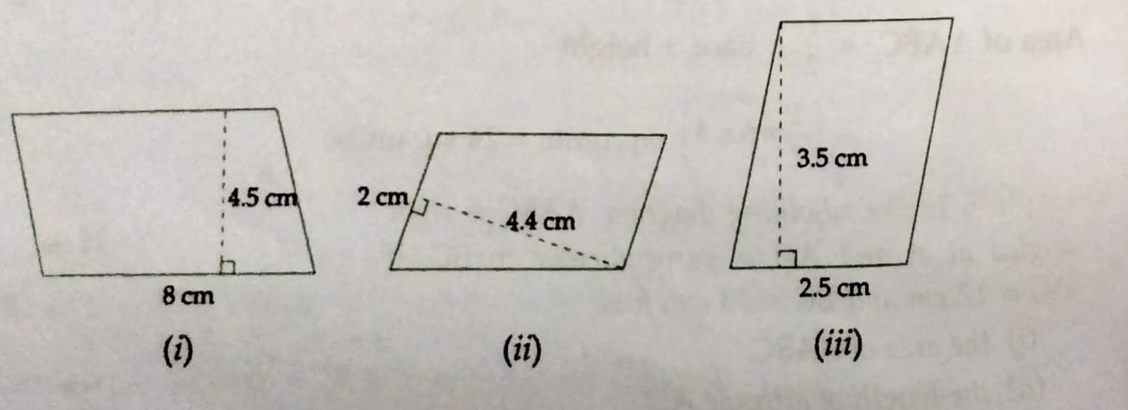
= area of rect. ABCD – area of ΔEBC – area of ΔGAE – area of ΔDGF

$= (20 \times 12 - \frac{1}{2} \times 14 \times 12 - \frac{1}{2} \times 6 \times 7 - \frac{1}{2} \times 12 \times 5) \text{ cm}^2$

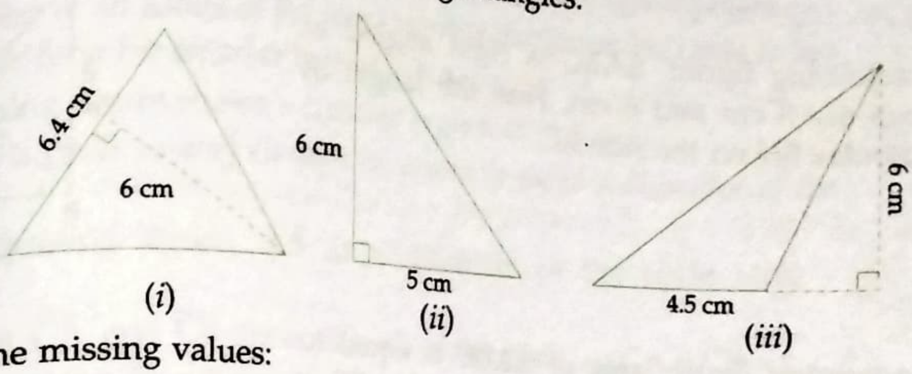
$= (240 - 84 - 21 - 30) \text{ cm}^2 = 105 \text{ cm}^2$.

Exercise 16.2

1. Find the area of each of the following parallelograms:



2. Find the area of each of the following triangles:



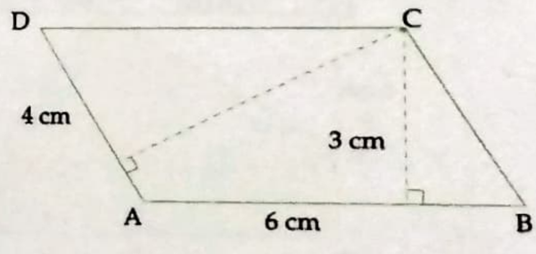
3. Find the missing values:

	Base	Height	Area of parallelogram
(i)	7.5 cm	5.6 cm	....
(ii)	20 cm	....	246 cm^2
(iii)	....	15 cm	154.5 cm^2
(iv)	....	8.4 cm	48.72 cm^2

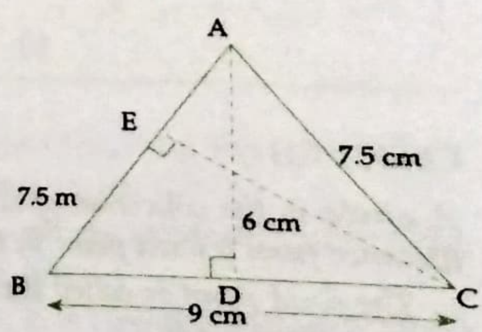
4. Find the missing values:

	Base	Height	Area of triangle
(i)	23.2 m	16.7 m	....
(ii)	15 cm	....	87 cm^2
(iii)	22 mm	....	170.5 mm^2
(iv)	....	31.4 cm	1256 cm^2

5. In the adjoining figure, ABCD is a parallelogram whose two adjacent sides are 6 cm and 4 cm. If the height corresponding to the base AB is 3 cm, find:
   (i) the area of parallelogram ABCD
   (ii) the height corresponding to the base AD.

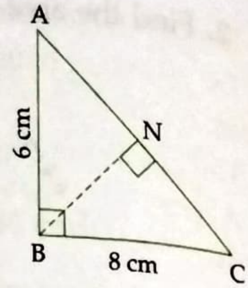


6. In the adjoining figure, ABC is an isosceles triangle with AB = AC = 7.5 cm and BC = 9 cm. If the height AD from A to BC is 6 cm, find:
   (i) the area of ΔABC
   (ii) the height CE from C to AB.

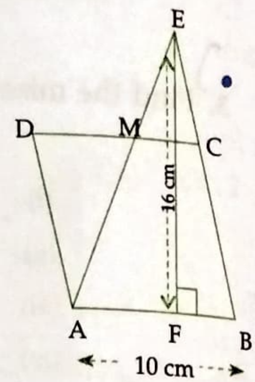


7. If the base of a right angled triangle is 8 cm and the hypotenuse is 17 cm, find its area.

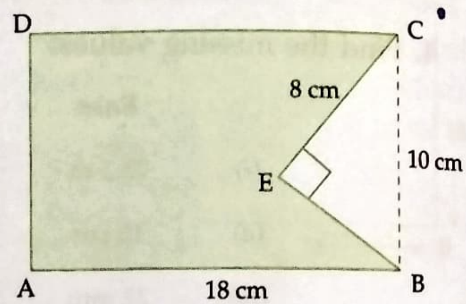
8. In the adjoining figure, ΔABC is right angled at B. Its legs are 8 cm and 6 cm. Find the length of perpendicular BN on the side AC.



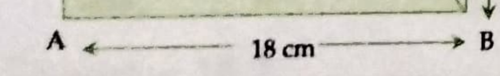
9. In the adjoining figure, area of ΔABE is equal to the area of parallelogram ABCD. If altitude EF is 16 cm long, find the length of the altitude of the parallelogram to the base AB of length 10 cm. What is the area of ΔAMD, where M is mid-point of side DC?



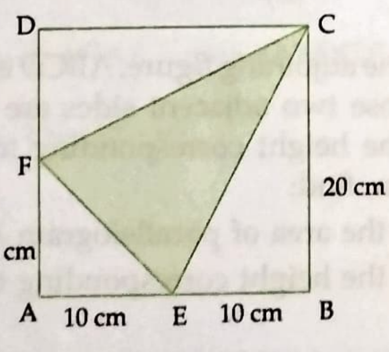
10. In the adjoining figure, ABCD is a rectangle of size 18 cm by 10 cm. In ΔBEC, $\angle E$ = 90° and EC = 8 cm. Find the area of the shaded region.



11. In the following figures, find the area of the shaded regions:



(i)



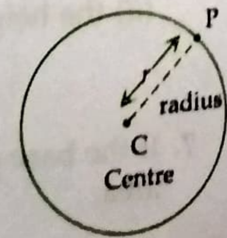
(ii)

CIRCLES

A circle is the collection of all those points, say P, in a plane each of which is at a constant distance from a fixed point in that plane.

The fixed point is called the centre and the constant distance is called the radius of the circle.

The radius of a circle is always positive.

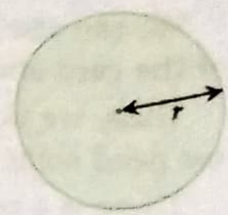


The adjoining figure shows a circle with C as its centre and r as its radius.

Note that the centre of a circle does not lie on the circle.

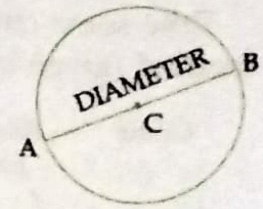
Remember, circle is the boundary only and all radii of a circle are equal.

The collection of all points of the plane which either lie on the circle or are inside the circle form the ***circular region.***



The adjoining figure shows a circular region of radius *r*.

A chord of a circle passing through its centre is called a ***diameter*** *of the circle.*



In the adjoining figure, $\overline{AB}$ is a diameter of the circle with centre C.

Notice that $\overline{CA}$ and $\overline{CB}$ are both radii of the circle, so CA = CB = *r*.

It follows that AB = 2*r* = 2 × radius. Thus:

***Length of diameter* = 2 × radius.**

Circumference of a circle

The length of the whole arc of a circle or the distance around a circular region is called the ***circumference*** *of the circle.*

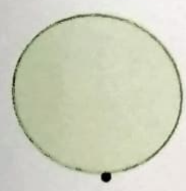
We cannot measure the length of the whole arc of a circle or the distance around a circular region with the help of a ruler as it is not straight. Here is a way to find the distance around a circular region. Let us learn it through an activity.

Activity 13

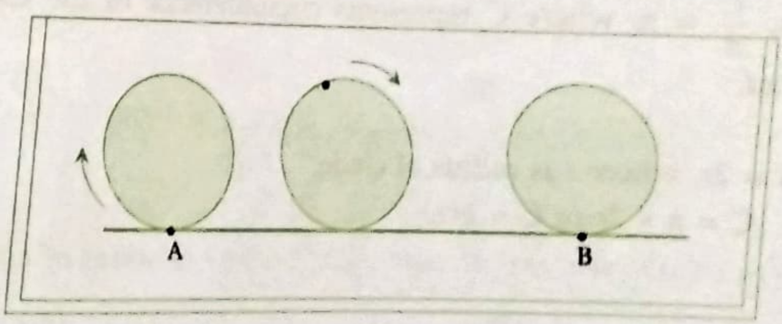
To measure the distance around a circular region

Steps

1. Take a circular card and mark a point on the edge of the card as shown in fig. (*i*).



(*i*)



(*ii*)

2. Place the card on the table with marked point of the card touching the table. Mark the position of the point on the table, call it A as shown in fig. (*ii*).
3. Roll the circular card on the table along a straight line till the marked point of the card again touches the table, call it B as shown in fig. (*ii*).
4. Measure the distance of the line segment AB by ruler. It is also the distance along the edge of the circular card from the marked point back to the marked point, which is the circumference of the circular card.

We can also find the distance around a circular card by wrapping a string on the edge of the card and taking all round it.

Thus, we notice that measuring distance around circular objects is very difficult. So, we need some formula for this.

There is a relationship between the diameter and the circumference of circles.

Take some circles of different radii and find their circumference by using the above method (given in the activity) or by using string and complete the following table:

Circle	*Radius* r	*Diameter* $d\ (= 2r)$	*Circumference* C	*Ratio of circumference to diameter* $\frac{C}{d}$
(*i*)	3.5 cm	7 cm	22 cm	$\frac{22}{7}$ = 3.14 (approx.)
(*ii*)	7 cm	14 cm	44 cm	$\frac{22}{7}$ = 3.14
(*iii*)	10.5 cm	21 cm	66 cm	$\frac{22}{7}$ = 3.14
(*iv*)	14 cm	28 cm	88 cm	$\frac{22}{7}$ = 3.14
(*v*)	5 cm	10 cm	31.5 cm	3.15
(*vi*)	10 cm	20 cm	62.5 cm	3.125

We notice that this ratio is approximately same.

In each case ratio of circumference to diameter *i.e.* $\frac{C}{d}$ is constant $= \frac{22}{7} = 3.14$ (approximately).

This constant ratio is denoted by π (read as *'pi'*) and its approximate value is $\frac{22}{7}$ or 3.14.

Thus, $\frac{C}{d} = \pi$, where C represents circumference of the circle and d its diameter

$\Rightarrow C = \pi d$.

Thus, circumference of a circle = πd, where d is diameter of circle.

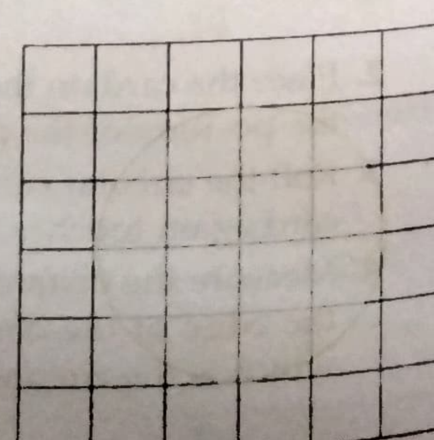
But $d = 2r$, where r is radius of circle.

$\therefore \quad C = \pi \times 2r$ or $C = 2\pi r$.

Hence, circumference of a circle = $2\pi r$, where r is radius of circle.

Area of a circle

The area of the region enclosed by a circle is called the area of the circle.



Draw a circle of radius 2 units on a squared paper of side 1 unit (as shown in the adjoining figure). Find the area of the region enclosed by the circle by counting the number of squares enclosed. It is approximately 12 sq. units.

As the edges are not straight, we get only a rough estimate of the area of the circle by this method.

There is another way to find the area of a circle. Let us learn it through an activity.

Activity 14

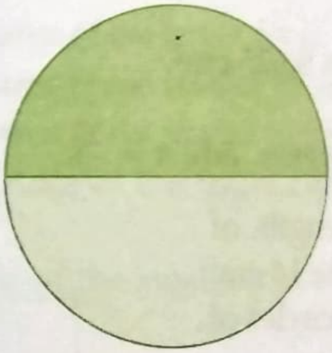
To find a formula for the area of a circle

Materials required

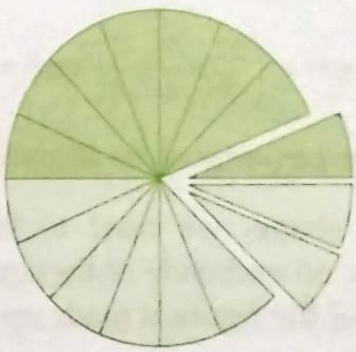
(i) Drawing sheet and white sheet
(ii) Geometry box
(iii) Pair of scissors
(iv) Fevistick/gum.

Steps

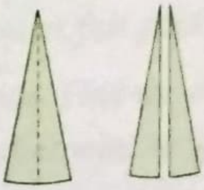
1. Draw a circle of any radius, say r units, on a drawing sheet as shown in fig. (*i*).
2. Draw a diameter of the circle. Shade half of circular region in light colour and the other half region in dark colour as shown in fig. (*i*).
3. Divide the circular region into 16 equal parts as shown in fig. (*ii*). (The circular region can be divided into 16 equal parts by paper folding.)
4. Take any one part, say shaded in light colour, out of the above 16 equal parts of the circular region and further divide this part into two equal parts as shown in fig. (*iii*).
5. Paste all the parts of the circular region on a white sheet of paper as shown in fig. (*iv*).



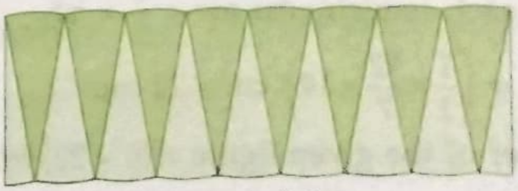
(*i*)



(*ii*)



(*iii*)



(*iv*)

Result

We observe that fig. (*iv*) formed by all the parts of the circular region looks like a rectangle (in fact, rectangular region).

Length of this rectangle = length of arc of a semicircle of radius $r = \frac{1}{2} \times 2\pi r = \pi r$

and breadth of rectangle = radius of the circle = r.

$\therefore$ Area of rectangle = length × breadth = $\pi r \times r = \pi r^2$.

Since the rectangle is obtained from parts of circular region, therefore.

area of circle = area of rectangle = πr^2.

Hence, area of circle = πr^2, where r is radius of circle.

In fact, by area of a circle we mean area of the circular region enclosed by the circle.

Example 1. *Find the circumference of a circle of diameter 10 cm. Take $\pi = 3.14$.*

Solution. Given, diameter of circle = d = 10 cm

Circumference of circle = $\pi d = (3.14 \times 10)$ cm = 31.4 cm.

Example 2. *Find the circumference and the area of a circular disc of radius 14 cm. Take $\pi = \frac{22}{7}$.*

Solution. Given, radius of circular disc = r = 14 cm.

Circumference of disc = $2\pi r = \left(2 \times \frac{22}{7} \times 14\right)$ cm = 88 cm.

Area of circular disc = $\pi r^2 = \left(\frac{22}{7} \times 14 \times 14\right)$ cm² = 616 cm².

Example 3. *Find the circumference and area of a circle of diameter 3.5 cm. Take $\pi = \frac{22}{7}$.*

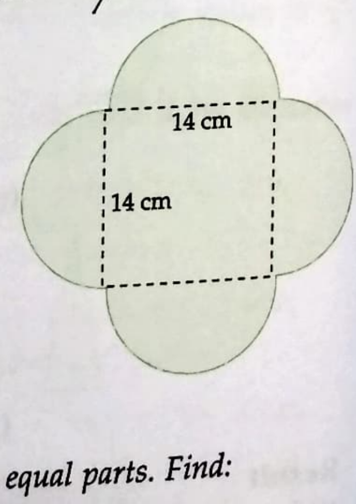
Solution. Given, diameter of the circle = 3.5 cm = $\frac{7}{2}$ cm,

$\therefore$ radius of circle = $\left(\frac{1}{2} \times \frac{7}{2}\right)$ cm = $\frac{7}{4}$ cm.

Circumference of circle = $2\pi r = \left(2 \times \frac{22}{7} \times \frac{7}{4}\right)$ cm = 11 cm.

Area of circle = $\pi r^2 = \left(\frac{22}{7} \times \frac{7}{4} \times \frac{7}{4}\right)$ cm² = $\frac{77}{8}$ cm² = 9.625 cm².

Example 4. *Find the perimeter of the adjoining shaded region. Take $\pi = \frac{22}{7}$.*



Solution. In this shape, we need to find the length of semicircular arc on each side of the square of side 14 cm. The boundary of the figure is made up of 4 semicircles of diameter 14 cm.

Length of each semicircular arc = $\frac{1}{2} \times \pi d$

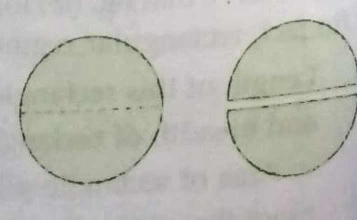
$= \left(\frac{1}{2} \times \frac{22}{7} \times 14\right)$ cm = 22 cm.

$\therefore$ Perimeter of the given figure = (4×22) cm = 88 cm.

Example 5. *Amrita divided a circular disc of radius 7 cm into two equal parts. Find:*

(i) the perimeter of each semicircular disc.

(ii) the area of each semicircular disc. Take $\pi = \frac{22}{7}$.



Solution. (*i*) Given, radius of circular disc = 7 cm

Length of semicircular arc = $\frac{1}{2} \times 2\pi r$

$= \left(\frac{22}{7} \times 7\right)$ cm = 22 cm, diameter of semicircle = $2r = (2 \times 7)$ cm = 14 cm.

$\therefore$ Perimeter of each semicircular disc = (22 + 14) cm = 36 cm.

(ii) Area of each semicircular disc = $\frac{1}{2} \times \pi r^2 = \left(\frac{1}{2} \times \frac{22}{7} \times 7 \times 7\right)$ cm^2 = 77 cm^2.

Example 6. *A circular radar screen has a circumference of 176 cm. Only 90% of its area is effective. Calculate the effective area of the screen.*

Solution. Let r cm be radius of the circular radar screen,

then its circumference = $2\pi r$.

According to given information, $2\pi r = 176$

$\Rightarrow \; 2 \times \frac{22}{7} \times r = 176 \Rightarrow r = 28.$

Area of the screen = $\pi r^2 = \left(\frac{22}{7} \times 28 \times 28\right)$ cm^2 = 2464 cm^2

As only 90% of the area of the radar screen is effective,

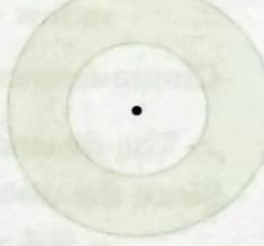
$\therefore$ the effective area of the screen = $\left(\frac{90}{100} \times 2464\right)$ cm^2 = 2217.6 cm^2.

Example 7. *The adjoining figure shows two circles with the same centre. The radius of the larger circle is 10 cm and the radius of the smaller circle is 4 cm. Find:*

(i) the area of the larger circle.

(ii) the area of the smaller circle.

(iii) the area of the shaded region. Take $\pi = 3.14$



Solution. (i) Area of the larger circle = $\pi r^2 = (3.14 \times 10 \times 10)$ cm^2

$= 314$ cm^2.

(ii) Area of the smaller circle = $\pi r^2 = (3.14 \times 4 \times 4)$ cm^2

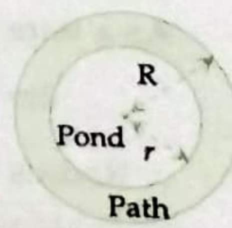
$= (3.14 \times 16)$ cm^2 = 50.24 cm^2

(iii) Area of the shaded region = (314 – 50.24) cm^2 = 263.76 cm^2.

Example 8. *A circular fish pond has a diameter of 14 m. The pond is surrounded by a concrete path 1.75 m wide. Find the area of the path. Take $\pi = \frac{22}{7}$.*

Solution. Given diameter of the fish pond = 14 m,

radius of the pond $r = \left(\frac{1}{2} \times 14\right)$ m = 7 m.



Width of the circular path = 1.75 m.

Let R be the radius of the outer circle.

Then R = 7 m + 1.75 m = $\left(7 + \frac{7}{4}\right)$ m = $\frac{35}{4}$ m.

Area of the path $= \pi R^2 - \pi r^2 = \pi(R^2 - r^2)$

$$= \frac{22}{7}\left(\frac{35}{4} \times \frac{35}{4} - 7 \times 7\right) \text{m}^2 = 22\left(\frac{175}{16} - 7\right) \text{m}^2$$

$$= 22\left(\frac{175 - 112}{16}\right) \text{m}^2 = \frac{11 \times 63}{8} \text{m}^2 = \frac{693}{8} \text{m}^2 = 86.625 \text{ m}^2.$$

Example 9. *The area of a circular ring enclosed between two concentric circles is 286 cm². Find the radii of the two circles, given that their difference is 7 cm.*

Solution. Let the radii of the outer and inner circles be R cm and r cm respectively.

According to the given information,

$$R - r = 7 \quad \text{...(i)}$$

and $\pi (R^2 - r^2) = 286 \Rightarrow \pi (R - r)(R + r) = 286$

$\Rightarrow \frac{22}{7} \times 7 \times (R + r) = 286$ (using (i))

$\Rightarrow R + r = 13$ ...(ii)

Adding (i) and (ii), we get

$2R = 20 \Rightarrow R = 10.$

Subtracting (i) from (ii), we get

$2r = 6 \Rightarrow r = 3.$

$\therefore$ The radii of the two circles are 10 cm and 3 cm.

Example 10. *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?*

Solution. Given, diameter of the bicycle = 70 cm

$\therefore$ radius $= r = \frac{70}{2}$ cm = 35 cm

Circumference of the wheel $= 2\pi r = \left(2 \times \frac{22}{7} \times 35\right)$ cm = 220 cm.

$\therefore$ The distance covered by the wheel in one revolution = 220 cm.

Since the distance to be covered by the wheel = 4.4 km

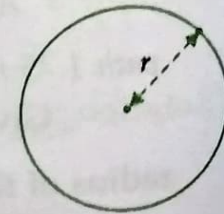
$= (4.4 \times 1000 \times 100)$ cm $= (44 \times 10000)$ cm,

$\therefore$ the number of times the wheel would rotate $= \frac{44 \times 10000}{220} = 2000.$

Example 11. *Arvind took a wire of length 44 cm and bent it into the shape of a circle. Find the area enclosed by that circle. If the same wire is bent into the shape of a square, then find the area enclosed by that square. Which shape encloses more area and by how much? Take $\pi = \frac{22}{7}$.*

Solution. Let r cm be the radius of the circle,

then circumference $= 2\pi r$.



As a wire of length 44 cm is bent into the shape of circle, so

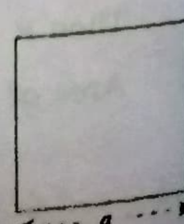
$2\pi r = 44 \Rightarrow 2 \times \frac{22}{7} \times r = 44 \Rightarrow r = 7.$

$\therefore$ Radius of circle = 7 cm

Area enclosed by the circle $= \pi r^2 = \left(\frac{22}{7} \times 7 \times 7\right)$ cm² = 154 cm²

Let a cm be the side of the square,

perimeter of square $= 4a$.



As the same wire is bent into the shape of square,

$4a = 44 \Rightarrow a = 11.$

$\therefore$ Side of the square = 11 cm

Area enclosed by the square = (side)² = (11×11) cm² = 121 cm²

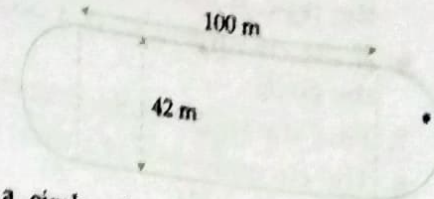
∴ Area of circle – area of square = $(154 - 121)\ cm^2 = 33\ cm^2$.

Hence, circle encloses more area by $33\ cm^2$.

Example 12. *The adjoining sketch represents a sports field which consists of a rectangle and two semicircles. Calculate:*

(i) the area of the field.

(ii) the length of the boundary of the field.



Solution. The two semicircles put together make a circle of diameter 42 m *i.e.* of radius 21 m.

(*i*) Area of the field = area of rectangle + area of two semicircles

$= (100 \times 42)\ m^2 + \pi r^2 = 4200\ m^2 + \left(\frac{22}{7} \times 21 \times 21\right) m^2$

$= (4200 + 1386)\ m^2 = 5586\ m^2$.

(*ii*) The boundary of the field consists of two line segments, each of length 100 m and two semicircular arcs of radius 21 m.

∴ The length of the boundary $= (2 \times 100)\ m + 2\pi r = 200\ m + \left(2 \times \frac{22}{7} \times 21\right) m$

$= 200\ m + 132\ m = 332\ m$.

Example 13. *In the adjoining figure, the points A, B and C are centres of arcs of circles of radii 5 cm, 3 cm and 2 cm respectively. Find the perimeter and the area of the shaded region. (Leave the answer in π.)*

Solution. Perimeter of the shaded region

$= \left(\frac{1}{2} \times 2\pi \times 5 + \frac{1}{2} \times 2\pi \times 3 + \frac{1}{2} \times 2\pi \times 2\right) cm$

$= \pi\ (5 + 3 + 2)\ cm = 10\pi\ cm$.

Area of the shaded region

$= \left(\frac{1}{2} \times \pi \times 5^2 - \frac{1}{2} \times \pi \times 3^2 + \frac{1}{2} \times \pi \times 2^2\right) cm^2$

$= \frac{\pi}{2}\ (25 - 9 + 4)\ cm^2 = 10\pi\ cm^2$.

Exercise 16.3

Take $\pi = \frac{22}{7}$, unless stated otherwise.

1. Find the circumference of the circles with the following radius:

   (*i*) 7 cm (*ii*) 21 cm (*iii*) 28 mm (*iv*) 3.5 cm.

2. Find the area of the circles, given that:

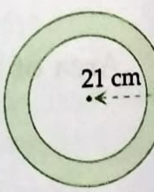
   (*i*) radius = 14 mm (*ii*) diameter = 49 m

   (*iii*) diameter = 9.8 m (*iv*) radius = 5 cm

3. Find the circumference and area of a circle of radius 20 cm. (use $\pi = 3.14$)

4. The minute hand of a tower clock is 1.4 m long. How far does the tip of the hand move in 1 hour?

5. A gardener wants to fence a circular garden of diameter 21 m. Find the length of the rope he needs to purchase, if he makes 2 rounds of fence. Also find the cost of the rope, if it costs ₹4 per metre.
6. If the circumference of a circle exceeds its diameter by 30 cm, find the radius of the circle.
7. Find the length of the diameter of a circle whose circumference is 44 cm.
8. The circumference of a circle is 31.4 cm. Find the radius and the area of the circle. (Take $\pi = 3.14$)
9. Find the radius and the circumference of a circle whose area is 144π cm^2.
10. How many times will the wheel of a car rotate in a journey of 88 km, given that the diameter of the wheel is 56 cm?
11. From a square cardboard of side 21 cm, a circle of maximum area is cut out. Find the area of the cardboard left.
[Hint. Diameter of circle of maximum area = 21 cm.]
12. A piece of wire is bent in the shape of an equilateral triangle of side 4.4 cm. If this wire is rebent to form of a circle, find the radius and the area of the circle.
13. A wire is in the form of a square of side 27.5 cm. It is straightened and bent into the shape of a circle. Find the area of the circle.
14. A wire is in the form of a rectangle 18.7 cm long and 14.3 cm wide. If this wire is reshaped and bent in the form of circle, find the radius and the area of the circle so formed.
15. The diameter of a circular park is 84 m. On its outside, there a 3.5 m wide road. Find the cost of constructing the road at ₹ 240 per m^2.
16. A circular pond is surrounded by a 2 m wide circular path. If the outer circumference of the circular path is 44 m, find the inner circumference of the circular path. Also find the area of the path.
17. 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.

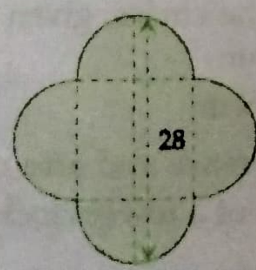


18. From a circular card sheet of radius 14 cm, two circles of radius 3.5 cm and a rectangle of length 3 cm and breadth 1 cm are removed (as shown in the adjoining figure). Find the area of the remaining sheet.

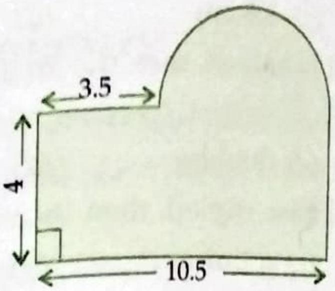
19. Calculate the length of the boundary and the area of the shaded region in the following diagrams. All measurements are in centimetres.

(*i*) Unshaded part is a semicircle

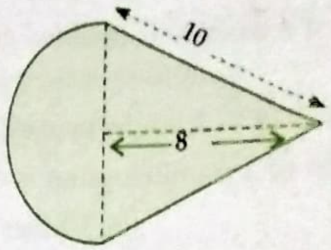
(*ii*) Four semicircles on a square.



20. Find the perimeter and the area of the shaded region in the following figures. All measurements all in centimetres.



(i)



(ii)

21. If a wire is bent in the shape of a square, the area of the square is 81 cm^2. When the same wire is bent into the form of a semicircular arc bounded by its diameter, find the area of the shape so formed. (take $\pi = \frac{22}{7}$).

Objective Type Questions

MENTAL MATHS

1. Fill in the blanks:
   (i) Perimeter of a regular polygon = ... × length of a side.
   (ii) The unit of measurement of area is .....
   (iii) The perimeter of a rhombus is = 4 × .....
   (iv) An area of 1 km^2 = ... hectare
   (v) If perimeter of a parallelogram is 40 cm and the length of one side is 12 cm, then the length of the adjacent side is .....
   (vi) To find the cost of polishing a table-top, we need to find the ..... of the table-top.
   (vii) The ratio of circumference to the diameter of a circle is ....
   (viii) If the area of a triangular piece of cardboard is 90 cm², then the length of the altitude corresponding to 20 cm long base is ... cm.
2. State whether the following statements are true (T) or false (F):
   (i) A diagonal of a rectangle divides it into two right angled triangles of equal areas.
   (ii) A diagonal of a parallelogram divides it into two triangles of equal areas.
   (iii) If perimeter of two parallelograms are equal, then their areas are also equal.
   (iv) All parallelograms having equal areas have same perimeters.
   (v) The area of a circle of diameter d is πd^2.
   (vi) Area of a parallelogram = product of lengths of its two adjacent sides.

MULTIPLE CHOICE QUESTIONS

Choose the correct answer from the given four options (3 to 14):

3. If the perimeter of a square is 24 cm, then its area is
   (a) 16 cm^2 (b) 24 cm^2 (c) 36 cm^2 (d) 36 m^2

4. If the area of a parallelogram is 54 cm^2 and the length of one side is 7.5 cm, then the corresponding height is
(a) 7.2 cm (b) 14.4 cm (c) 3.6 cm (d) 13.5 cm

5. If the base of a triangle is doubled and its height is halved, then the area of the resulting triangle
(a) decreases (b) increases (c) doubles (d) remains same

6. If the height of a parallelogram is doubled and base tripled, then its area becomes
(a) 2 times (b) 3 times (c) 6 times (d) 12 times

7. The circumference of the circle with diameter 28 cm is
(a) 44 cm (b) 88 cm (c) 176 cm (d) 616 cm

8. The ratio of circumference to the area of a circle of radius r units is
(a) $2 : r$ (b) $r : 2$ (c) $1 : r$ (d) $\pi : r$

9. If the area of a circle is numerically equal to its circumference, then the radius of the circle is
(a) 1 unit (b) 2 units (c) 3 units (d) 4 units

10. The area of a circle of diameter d is
(a) $2\pi d^2$ (b) πd^2 (c) $\pi \frac{d^2}{2}$ (d) $\frac{\pi d^2}{4}$

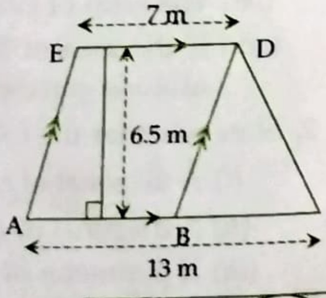
11. If the ratio of the radii of two circles is 2 : 3, then the ratio of their circumferences is
(a) 2 : 3 (b) 3 : 2 (c) 4 : 9 (d) 9 : 4

12. If the ratio of the radii of two circles is 3 : 5, then the ratio of their areas is
(a) 3 : 5 (b) 5 : 3 (c) 25 : 9 (d) 9 : 25

13. The perimeter of a semicircle (including its diameter) of radius 7 cm is
(a) 22 cm (b) 29 cm (c) 36 cm (d) 44 cm

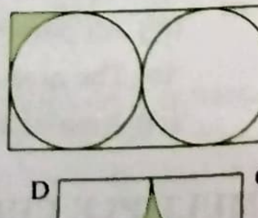
14. Area of a rectangle and the area of a circle are equal. If the dimensions of the rectangle are 14 cm × 11 cm, then the radius of the circle is
(a) 21 cm (b) 14 cm (c) 10.5 cm (d) 7 cm

Higher Order Thinking Skills (HOTS)

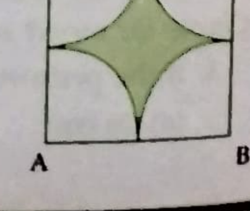


1. In the adjoining figure, ABDE is a parallelogram, find the area of the trapezium ACDE.

2. A rectangular plot is to be fenced on three sides, leaving a side of 20 m uncovered. If the area of the plot is 320 m^2, how many metres of fencing is required?



3. In the adjoining figure, the length of the rectangle is 28 cm. Find the area of the shaded region.



4. In the adjoining figure, ABCD is a square of side 14 cm. A, B, C and D are centres of circular arcs of equal radius. Find the perimeter and the area of the shaded region.

Summary

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

★ Area of a closed plane figure is the measure of the region (part of plane) enclosed by its boundary.

★ **Squares and rectangles**

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

❑ Area of a square = $(\text{length of a side})^2$

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

❑ Area of a rectangle = length × breadth

★ Area of a parallelogram = base × height.

★ Area of a triangle = $\frac{1}{2}$ × base × height.

★ The length of the whole arc of a circle or the distance around a circular region is called its circumference.

★ Circumference of a circle = πd, where d is length of a diameter of the circle and π is a constant number and its value = $\frac{22}{7}$ or 3.14 approximately.

★ If r is the radius of a circle, then

❑ length of a diameter = $2r$

❑ circumference of the circle = $2\pi r$

❑ area of the circle = πr^2.

★ By area of a circle we mean the area of the circular region enclosed by the circle.

★ **Conversion of units of area**

$1 \text{ cm}^2 = 100 \text{ mm}^2$, $1 \text{ m}^2 = 10000 \text{ cm}^2$, $1 \text{ km}^2 = 1000000 \text{ m}^2$,

$1 \text{ hectare} = 10000 \text{ m}^2$, $1 \text{ km}^2 = 100$ hectare.

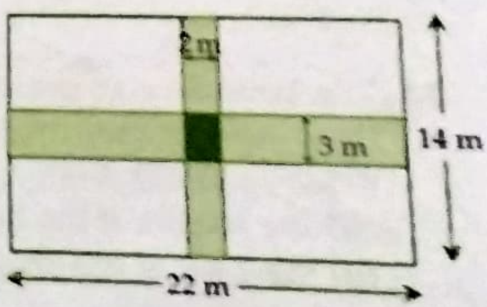
Check Your Progress

1. A 3m wide path runs outside and around a rectangular park of length 125 m and breadth 65 m. Find the area of the path.

2. In the adjoining figure, all adjacent line segments are at right angles. Find:

(*i*) the area of the shaded region

(*ii*) the area of the unshaded region.



3. Find the area of a triangle whose:

(*i*) base = 2 m, height = 1.5 m

(*ii*) base = 3.4 m and height = 90 cm.