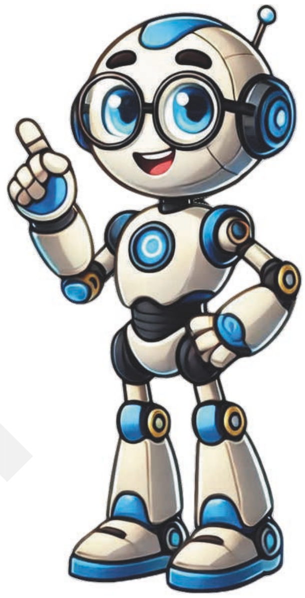
11
Chapter

Perimeter and Area

We'll cover the following key points:
- → Revision of perimeter
- → Circumference of a circle
- → Area

Do you Remember fundamental concept in previous class.
In class 5th we learnt
→ Concept of Area



Hi, I'm EeeBee

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Learning Outcomes

By the end of this chapter, students will be able to:

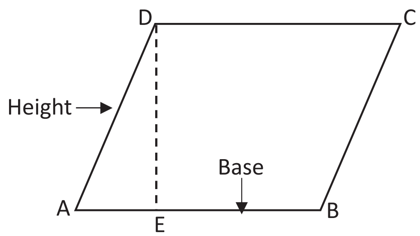
- Define perimeter and area and explain the difference between the two concepts for various 2D shapes.
- Calculate the perimeter of common 2D shapes, including rectangles, squares, triangles, and polygons, using the appropriate formulas.
- Calculate the area of common 2D shapes, such as rectangles, squares, triangles, and circles, by applying the relevant area formulas.
- Solve real-life problems involving the perimeter and area of irregular shapes, using appropriate methods of estimation and approximation.
- Understand and apply the concept of area in real-world contexts, such as calculating the area of a garden, floor space, or a piece of land.
- Use the formula for the area of composite shapes, by breaking them down into simpler shapes like rectangles and triangles.
- Understand and apply the perimeter and area of circles, including calculating the circumference using the formula $C = 2\pi r$, and the area using $A = \pi r^2$.

Mind Map

PERIMETER AND AREA

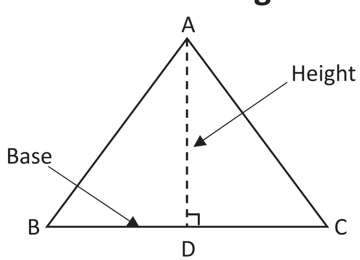
Area of a parallelogram

- Area = Base × Height



Area = AB × DE

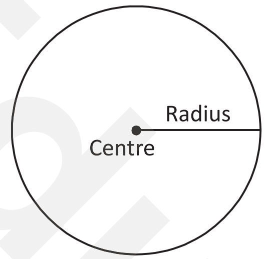
Area of triangle



Area of Δ = ½ × Base × Height

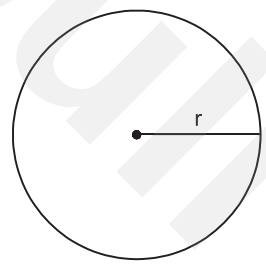
= ½ × BC × AD

Circles



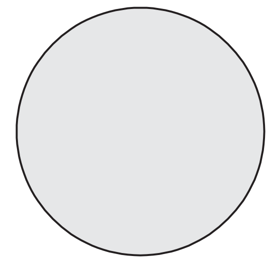
Circumference of circle

The distance around a circular region is known as its circumference



$C = 2\pi r$

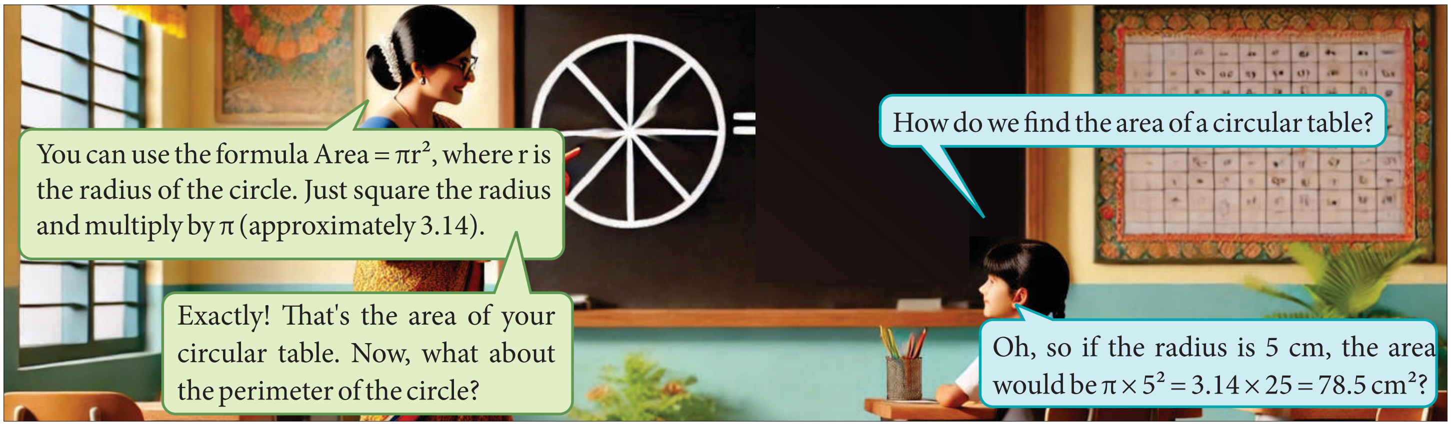
Area of circle



Area = πr^2

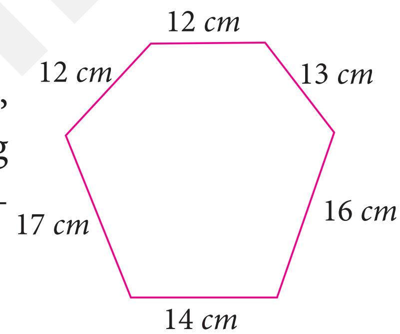
Based on NCERT*

Introduction



In a closed figure, we start from any point and reach at the same point by moving along the side and make one complete round. The distance thus covered is called **the perimeter of the closed figure**.

For determining perimeter, length and breadth must be in the same unit. The unit of perimeter is same as that of length and breadth.



For example : To find the perimeter of a park with six sides, 12 *cm*, 13 *cm*, 16 *cm*, 14 *cm*, 17 *cm* and 12 *cm*, we start adding the sides i.e., 12 *cm* + 13 *cm* + 16 *cm* + 14 *cm* + 17 *cm* + 12 *cm* = 84 *cm*.

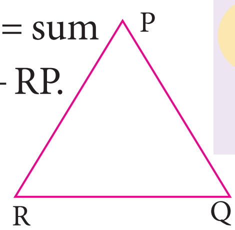
Thus, the perimeter of the park is 84*m*.

So, Perimeter of a closed figure = The sum of the lengths of all sides.

Take a Task   Watch Remedial

Perimeter of a Triangle

Perimeter of a triangle (say PQR) of three sides = sum of the lengths of all the three sides *i.e.*, PQ + QR + RP.



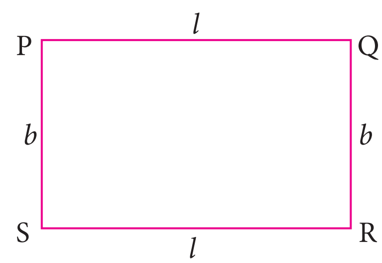
Perimeter of a Rectangle

Look at the rectangle in the following figure.

Let l be the length and b be the breadth of the rectangle PQRS.

Then, perimeter of the rectangle $= l + b + l + b = 2l + 2b$

$= 2\,(l + b) = 2$ (length + breadth)



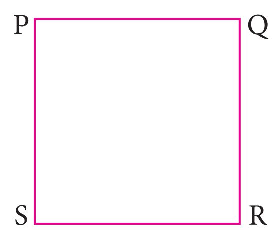
Hence, perimeter of a rectangle = 2 × (length + breadth).

Perimeter of a Square

Let s be the length of each side of a square PQRS.

Then, perimeter of a square $= s + s + s + s = 4s = 4 \times$ side

Also, the length of one side of the square $= \dfrac{\text{Perimeter}}{4}$.



Example 1 : The sides of a rectangular park measure 42 cm and 29 cm. Find its perimeter.

Solution : Length = 42 cm and breadth = 29 cm

Perimeter of the rectangle = 2 × (length + breadth)

$= 2 \times (42 + 29)\ cm = 2 \times 71\ cm = 142\ cm.$

Hence, the perimeter of the rectangular park is 142 cm.

Example 2 : If the perimeter of a square is 140 m, then find its side.

Solution : The perimeter of the square = 140 m

The side of the square $= \frac{\text{Perimeter of the square}}{4} = \frac{\cancel{140}^{35}}{\cancel{4}} m = 35\ m$

Thus, the side of the square is 35 m.

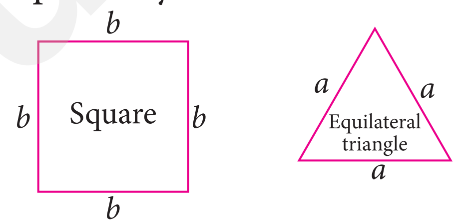
Example 3 : Both an equilateral triangle and a square have same perimeter x. Find difference in lengths of their sides .

Solution: Let the side of triangle and square be a and b respectively.

Therefore, $4b = x$ and $3a = x$

$\Rightarrow \quad b = \frac{x}{4}$ and $a = \frac{x}{3}$

Now, $\quad a - b = \frac{x}{3} - \frac{x}{4} = \frac{x}{12}$



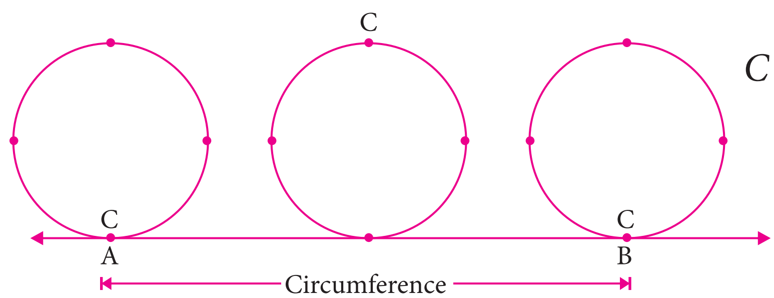
Take a Task

Watch Remedial

Circumference of a Circle

We know that perimeter of a plane figure is the 'distance around it' or the 'total length' of its sides. For a circle, instead of speaking perimeter, we usually use the term circumference to mean the distance around it. We also know that a circle does not contain any line segment. So, we cannot find the circumference of a circle by adding the measure of the segments.

To make an approximate measure of circumference, take a circular disc and mark a point C on its rim. Draw a line $\overline{AB}$ on a piece of paper and place the disc such that the point touches the line at A. Move the disc carefully along the line till the point C again touches the line at B. Now, measure the length of line segment $\overline{AB}$. This length gives the measure of the circumference of the circle.



Diameter and Circumference of a Circle

Let us take three or more than three circular objects of different radius. Find out their circumferences using the above method. Measure the diameter in each case and record them in the table as shown below :

Circles	Diameter (d)	Circumference (c)	Ratio $= c : d = \frac{c}{d}$
1.			
2.			
3.			

We will find that in each case the ratio $c : d$ is nearly equal to 3.1416 (correct up to four places of decimals).

Thus, we conclude that : The ratio of the circumference of a circle to its diameter is the same for all circles regardless of their size and is nearly equal to 3.14.

This value is denoted by the **Greek letter** π (read as pie).

In general, this relation is written as : $c = \pi d$

or $\quad c = 2\pi r \quad [\because d = 2r]$

Note

Since $\frac{22}{7}$ is also nearly equal to 3.14,

we can also write as $\frac{\text{Circumference}}{\text{Diameter}} = \frac{22}{7}$

or Circumference $= \frac{22}{7} \times$ Diameter $= 2 \times \frac{22}{7} \times$ Radius

Example 4 : Find circumference of a circle, whose diameter is 28 cm.

Solution : We have, diameter = 28 cm.

So, radius $= \frac{28}{2} = 14\ cm$

Let c be the circumference of the circle, then $c = 2\pi r$.

or, $$c = 2 \times \frac{22}{7} \times 14 = 88\ cm$$

Hence, the circumference of the circle is 88 *cm*.

Example 5 : The ratio of the radii of two circles is 3 : 7. The ratio of their circumference.

Solution : We have, ratio or radii = 3 : 7 .

So, let the radii of two circles be $3r$ and $7r$ respectively.

Let c_1 and c_2 be the circumferences of two circles respectively.

Then $$c_1 = 2\pi \times 3r = 6\pi r \text{ and } c_2 = 2\pi \times 7r = 14\pi r$$

$$\therefore \quad \frac{c_1}{c_2} = \frac{6\pi r}{14\pi r} = \frac{\cancel{6}^{3}}{{}_{7}\cancel{14}} = \frac{3}{7}$$

Hence, $c_1 : c_2 = 3 : 7$.

Example 6 : The radius of the wheel of a car is 21 *cm*. How many times will it revolve to travel a distance of 66 *km* ?

Solution : Radius of the wheel of a car = 21 *cm*

Circumference of the wheel of the car = $2\pi r$

$$= 2 \times \frac{22}{\cancel{7}} \times \cancel{21}^{3}\ cm = 132\ cm$$

Since in one revolution the car travels a distance equal to the circumference of the wheel, distance travelled by car in one revolution = 132 *cm*.

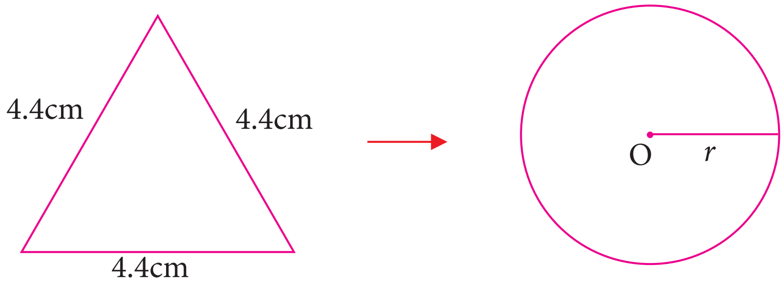
Total distance travelled by car = 66 *km* = 66 × 100000 *cm* = 6600000 *cm*

$$\therefore \text{ Number of revolutions} = \frac{6600000cm}{132cm} = 50{,}000$$

Hence, the wheel of the car will revolve 50,000 times to travel a distance of 66 *km*.

Example 7 : A piece of wire is bent in the shape of an equilateral triangle each of sides 4.4 cm. If it is re-bent to form a circular ring. What is the diameter of the ring so formed ?

Solution :



Length of the wire = Perimeter of the triangle

$= 3 \times \text{side of the triangle} = 3 \times 4.4\ cm = 13.2\ cm$

Now, the wire has been converted into a circular ring.

Let the radius of the ring be r.

Then, circumference of the ring $= 2\pi r$

i.e., $\quad 2\pi r = 13.2\ cm$

or $\quad 2 \times \frac{22}{7} \times r = 13.2cm$

or $\quad r = \frac{\cancel{132}^{\cancel{6}3} \times 7}{10 \times_1 \cancel{2} \times_1 \cancel{22}}\ cm = \frac{21}{10}\ cm = 2.1\ cm$

$\therefore \quad \text{diameter} = 2 \times 2.1\ cm = 4.2\ cm$

Hence, diameter of the ring so formed is 4.2 cm.

Exercise 11.1

1. Find the perimeter of each of the following :

(*i*) A ΔPQR in which PQ = 8.5 cm, QR = 6.2 cm and PR = 4.9 cm.

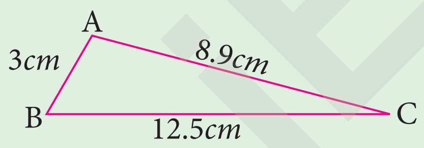
(*ii*) A square whose each side is 7.9 cm.

(*iii*) A rectangular park whose length is $46\frac{1}{2}\ m$ and breadth is $23\frac{1}{2}\ m$.

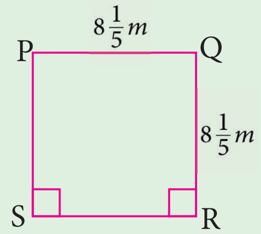
(*iv*) A rectangular field whose breadth is 49.9 m and length is 51.1 m.

2. Find the perimeter of each figure given below :

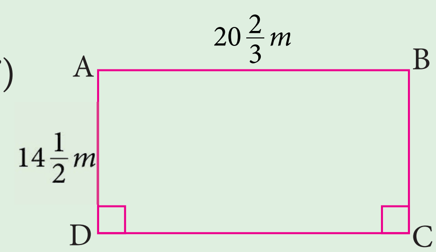
(*i*)



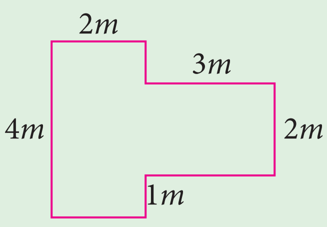
(*ii*)



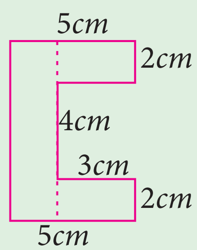
(*iii*)



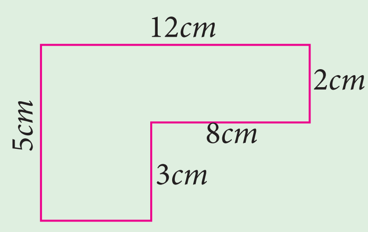
(*iv*)



(*v*)



(*vi*)



3. The perimeter of ΔABC is 50 cm. Its sides AB, BC and AC are respectively 15 cm, 10 cm and $(x + 4)$ cm. Find the value of x?

4. The breadth of a rectangular park is of 48 m. If 3 km 72 m long wire is required for fencing it, find the length of the park.

5. The perimeter of a square is double that of a rectangle. If perimeter of the square is 120 m, and length and breadth of the rectangle are in the ratio 3:2, find the breadth of the rectangle.

6. **Find the circumference of a circle whose radius is :**

(*i*) 10.5 cm (*ii*) 4.55 cm (*iii*) 4.2 cm (*iv*) 7 cm

7. **Find the circumference of a circle whose diameter is :**

(*i*) 14 cm (*ii*) 28 cm (*iii*) 10 cm (*iv*) 7 cm

8. **Find the radius of a circle whose circumference is :**

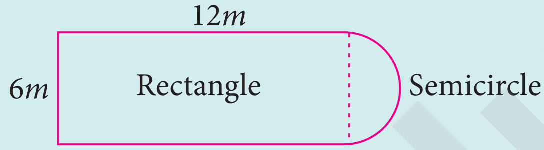
(*i*) 44 m (*ii*) 22 cm (*iii*) 66 m (*iv*) 30.8 m

HOTS (Higher Order Thinking Skills)

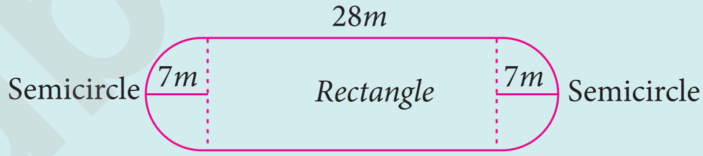
Critical Thinking

1. Find the perimeter of each figure :

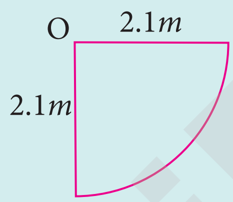
(*i*)



(*ii*)



(*iii*)



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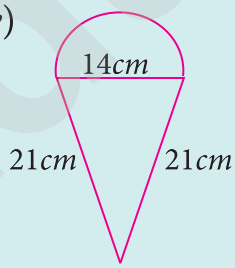
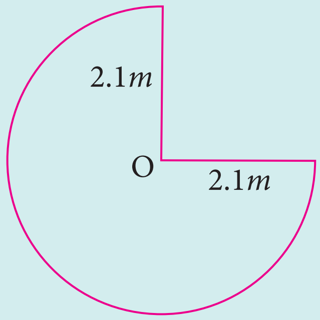


(*v*)



2. The ratio of circumferences of two circles is 5 : 3. What is the ratio of their radii ?

Area

About Area

In everyday life, we come across regions enclosed by the figures of various shapes such as triangular region, circular region, rectangular region etc. Here, by region, we mean the part of a plane enclosed by a simple figure together with its interior.

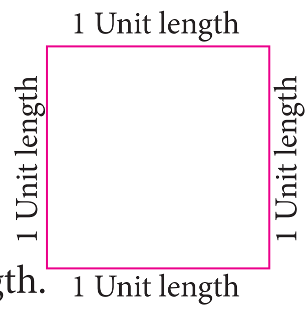
In two plane regions, we can talk of their comparison, that is, one being larger than the other or equal to the other. The comparison is done in terms of the magnitudes (or sizes) of the surface occupied.

The measurement of the magnitude of surface occupied by a figure is known as its **area**.

Measurement of Area

We can measure a region by a unit region and find out how many times the unit region is contained in the given region. Normally, a square region is taken as unit region or unit area.

The unit area is the area of a square with side 1 *cm*. It is written as 1 cm^2 or 1 square centimeter or 1 sq *cm*. The bigger unit of area is taken as 1 sq. metre or 1 m^2 or 1 sq. *m*. So, '1m^2' is the region (or surface) occupied by square of side 1 *m*.

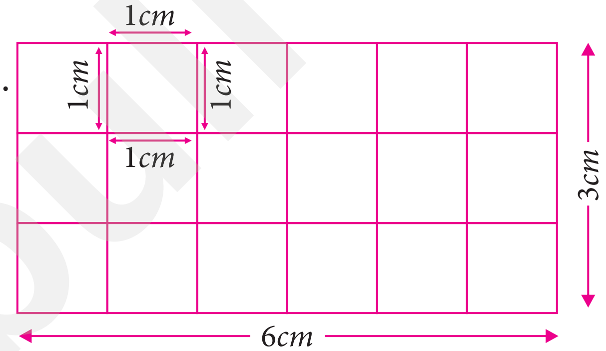


1 cm^2 is called a standard unit of area, just as 1 *cm* is a standard unit of length.

Area of a Rectangle

Let us consider the following figure:

It is a rectangle with length as 6 *cm* and breadth as 3 *cm*. We divide its lengths into six equal parts so that the length of each part becomes 1 *cm*. Similarly, we divide its breadth into 3 equal parts so that the length of each part becomes again 1 cm. Now, join each of these corresponding opposite points.



The region is divided into 18 equal small squares with length as 1 *cm*. Thus, we can say the area of a region with length and breadth as 6 *cm* and 3 *cm* respectively is 18 sq. *cm* or 18 cm^2.

We also find that

$$6\text{ cm} \times 3\text{ cm} = 18\text{ cm}^2$$

$$\boxed{\text{Length}} \times \boxed{\text{Breadth}} = \boxed{\text{Area of the rectangle}}$$

Therefore, it is concluded that

$$\boxed{\text{Area of a rectangle} = \text{Length} \times \text{Breadth}}$$

From the above relation, we can also get :

(*i*) $\text{Length} = \dfrac{\text{Area}}{\text{Breadth}}$

(*ii*) $\text{Breadth} = \dfrac{\text{Area}}{\text{Length}}$

REMEMBER

If the length and breadth are not given in the same unit, they must be converted into the same unit before alculating the area.

Take a Task

Watch Remedial

Example 8 : If the length of a rectangle is 16 *cm* and the length of its diagonal is 20 *cm*, then find the area of the rectangle .

Solution : In right triangle ABC, right angled at B, using Pythagoras Theorem, we have,

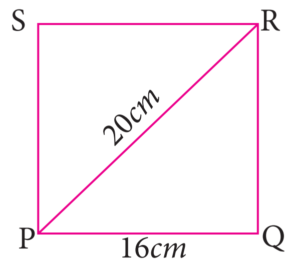
$$\Rightarrow \quad PR^2 = PQ^2 + QR^2$$

$$\Rightarrow \quad (20)^2 = (16)^2 + QR^2$$

$$\Rightarrow \quad 400 - 256 = QR^2$$

$$\Rightarrow \quad 144 = QR^2$$

$$\Rightarrow \quad QR = 12\,cm$$



(Breadth of the rectangle)

Now, area of the rectangle PQRS

$$= PQ \times RS$$

$$= 16 \times 12\,cm^2 = 192\,cm^2$$

Example 9 : Find the cost of painting a rectangular cardboard at the rate of 10 paise per square *cm*. The length and breadth of the cardboard are 90 *cm* and $\frac{3}{4}$ metre respectively.

Solution : Length of the rectangle = 90 *cm*

Breadth of the rectangle $= \frac{3}{4}m = \frac{3}{\cancel{4}} \times \cancel{100}^{25}\,cm = 75\,cm$

Since, area of the rectangle = length × breadth

∴ the area of the given rectangle = 90 *cm* × 75 *cm* = 6,750 sq. *cm*

Cost of painting for 1 sq. *cm* = 10 paise

∴ cost of painting 6,750 sq. *cm* = 6, 750 × 10 paise

$$= ₹\,\frac{6{,}75\cancel{0} \times 1\cancel{0}}{1\cancel{0}\cancel{0}} = ₹675$$

Thus, the cost of painting the cardboard is ₹675.

Example 10 : Find the area of a rectangle, if:

(*i*) its length and breadth are doubled.

(*ii*) its length and breadth are trippled.

Solution : Let *l* cm and *b* cm respectively be the length and breadth of the rectangle. Further, let A be the area of the rectangle.

Then, $A = l \times b$ ...(1)

(*i*) We have,

$$\text{New length} = 2l, \text{New breadth} = 2b$$

$$\therefore \quad \text{New area} = A_1 = 2l \times 2b$$

$$= 4(l \times b) = 4A \quad \text{[using (1)]}$$

Hence, the area of the new rectangle is 4 times the area of the previous rectangle.

(*ii*) We have,

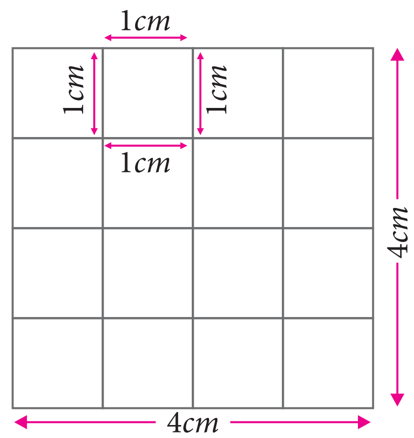
$$\text{New length} = 3l, \text{New breadth} = 3b$$

$$\text{New area} = A_1 = 3l \times 3b$$

$$= 9(l \times b) = 9A \quad \text{[using (1)]}$$

Hence, the area of the new rectangle is 9 times the area of the previous rectangle.

Area of a Square



Observe the adjoining figure of a square. It is divided into smaller squares of 1 cm side. There are 4 smaller squares in each row and 4 rows in all. Thus, total number of squares is 16 .

Here, we get :

$4\,cm \times 4\,cm = 16\,cm^2$

↑ Side × ↑ Side = ↑ Area of the Square

Thus, Area of a Square = (Side × Side) sq. units.

Note

Conversion of Units

1. The basic unit of area in the metric system (S.I. system) is '1 square metre' or 1 sq. *m*.

   1 sq. *m* = 10,000 sq. *cm*, 1 sq. *m* = 100 sq. *dm*

   1 sq. *dm* = 100 sq. *cm*, 1 sq. *cm* = 100 sq. *mm*

2. Area of a region formed by a square of side one decameter (1 dam) is 1 sq. dam and it is called "an are". 1 are = 100sq.*m*

3. Area of the region formed by a square of side one hectometre (1 hm) is 1 square hectometre ($1hm^2$) and it is called as "a hectare" or (1 ha).

$$1 \text{ ha} = 10{,}000 \text{ sq.m}$$

4. Area of the region formed by a square of side one Kilometre (1 km) is called a square kilometre ($1km^2$). $1 \text{ km}^2 = 10{,}00{,}000$ sq. m

Example 11 : The side of a square field is $50m$ long. Calculate the area of the square.

Solution : Length of side of the field = 50 m

Now, area of a square = side × side = $50m \times 50m = 2500\ m^2$

Hence, area of the square field is 2500 m^2 or 2500 sq. m.

Example 12 : Find :

(i) side of the square (in metre) whose area is 1 hectare.

(ii) side of the square (in decametre) whose area is 100 arcs.

Solution: (i) We know that 1 hectare = 10000 m^2.

Now, area of the square is 10000 m^2.

Also, $(\text{side})^2 = 10000\ m^2$

i.e. $\text{side} \times \text{side} = 100\ m \times 100\ m$

i.e. $\text{side} = 100\ m$

Hence, the required side of the square is 100 m.

(ii) 100 arcs = $(100 \times 100)\ m^2 = 10000\ m^2$. $(\because 1 \text{ arc} = 100\ m^2)$

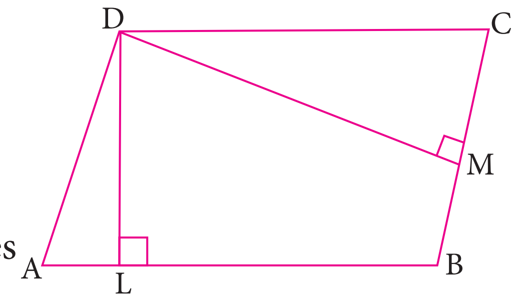
Now, area of the square is 10000 m^2.

i.e. $(\text{side})^2 = 10000\ m^2$

i.e $\text{side} = 100\ m = \frac{100}{10}\text{ dam} = 10 \text{ dam}$

Hence, the side of the square is 10 dam.

Area of a Parallelogram / Rhombus



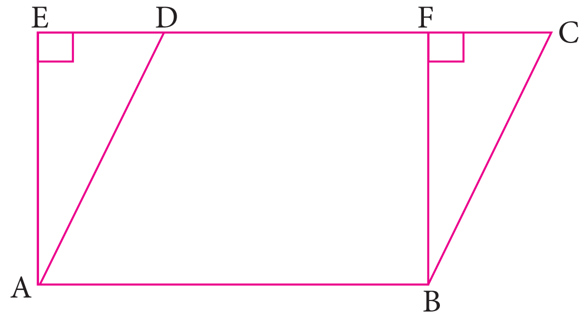
In the following figure, ABCD is a parallelogram where AB || DC and BC || AD.

If DL ⊥ AB, then DL is the distance between the parallel lines DC and AB.

Similarly, if DM ⊥ BC, then DM is the distance between parallel lines AD and BC.

Thus, DL and DM are the altitudes on the corresponding bases AB and BC respectively.

We shall use the word base and corresponding altitude (or height) for the length of a base and the corresponding altitude respectively.



Let us do the following activity to find the area of a parallelogram.

Draw a parallelogram ABCD. Let us call AB as a base of the parallelogram. Draw AE and BF as two altitudes of the parallelogram. Now, ABFE is a rectangle.

Cut off the right angled triangle BFC carefully and place it at the triangle AED. We will observe that both the triangles fit each other exactly. We can repeat this experiment with two other parallelograms.

Thus, a parallelogram and a rectangle on the same base and having same altitude (height) have equal areas.

It follows that,

Area of parallelogram (ABCD) = Area of rectangle (ABFE) = AB × AE

Let AB = b and AE = h, where b is the base and h the corresponding altitude of parallelogram ABCD.

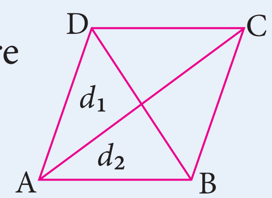
Thus, area of parallelogram ABCD = $b \times h$

i.e., area of parallelogram = base × corresponding altitude

Note

1. Since rhombus is a parallelogram with all its sides equal, the formula for area will be equally applicable to both.
2. However, if the lengths of two diagonals d_1 and d_2 of a rhombus are given, then area of the rhombus can be found out by the formula,

$$A = \frac{1}{2} \times d_1 \times d_1$$



Example 13 : Find the area of a parallelogram, whose base is 16 *dm* and the corresponding height is 49 *cm*.

Solution : The area of a parallelogram A = base × height

Here, base = 16 dm = 160 cm and height = 49 cm.

area of the parallelogram = 160 $cm \times$ 49 cm = 7840 cm^2

Hence, the area of the parallelogram is 7840 cm^2.

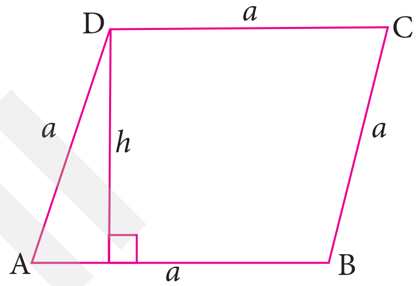
Example 14: The area of a rhombus is 56 m^2. If its perimeter is 56 m, find its altitude.

Solution: Let the side of the rhombus be a and corresponding altitude be h.

Now, perimeter of the rhombus $= a + a + a + a = 4a$

i.e. $56\,m = 4a$

or $a = \frac{56}{4} = 14\,m$



Since rhombus is a parallelogram,

$\therefore$ area = base $\times$ altitude

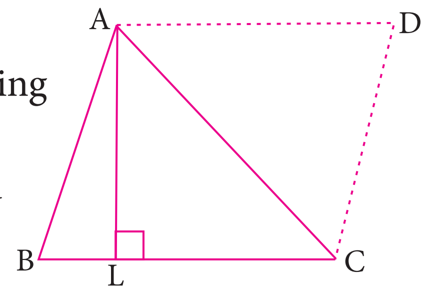
i.e. $56\,m^2 = 14\,m \times h$

$\therefore$ $h = \frac{56m^2}{14m} = 4m$

Hence, the altitude of the rhombus is 4 m.

Area of a Triangle

Let ABC be any triangle taking BC as its base. AL is its corresponding altitude as shown in the figure.



Through A and C, draw lines parallel to BC and AB respectively intersecting at D.

Observe that ABCD is a parallelogram.

We can also observe that ΔADC covers ΔABC exactly with C at A, D at B and A at C.

REMEMBER

A diagonal of a parallelogram bisects the parallelogram into two equal regions.

Thus, area of ΔABC = area ΔADC

$= \frac{1}{2}$(Area of parallelogram ABCD)

$= \frac{1}{2} \times$ base BC $\times$ altitude AL

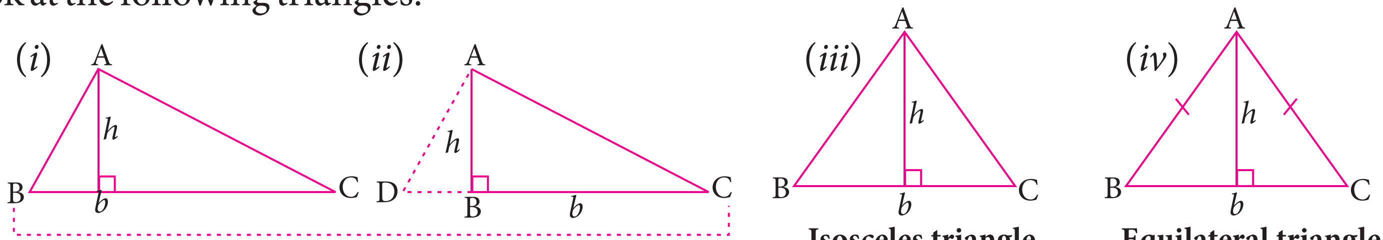
Thus, area of ΔABC $= \frac{1}{2} \times$ base BC $\times$ altitude AL $= \frac{1}{2} \times b \times h$,

where b and h are the base and altitude respectively.

Hence, area of a triangle = $\frac{1}{2} \times$ base $\times$ corresponding altitude

Note : The area of a triangle is half the area of a parallelogram on the same base and having same altitude.

Look at the following triangles:



Scalene triangle **Isosceles triangle** **Equilateral triangle**

Figures (*i*) and (*ii*) show scalene triangles, figures (*iii*) and (*iv*) show isosceles triangle and equilateral triangle respectively.

Observe the base b and corresponding altitude (i.e. height) h of the each type of triangle.

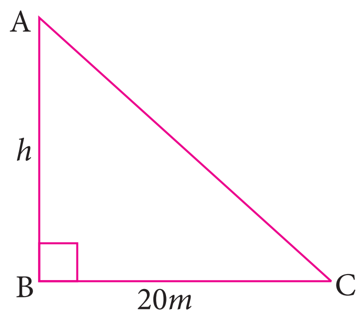
We can use the above formula to find the area of the each type of triangle

i.e., area $= \frac{1}{2} \times$ base $\times$ corresponding altitude

Example 15 : The area of a right triangle is 50 sq.*m*. If one of the legs is 20 *m*, then find the length of the other leg.

Solution : In a right triangle, if one of the legs is the base, the other leg is the altitude.

Here, area of the right triangle $= 50\ m^2$



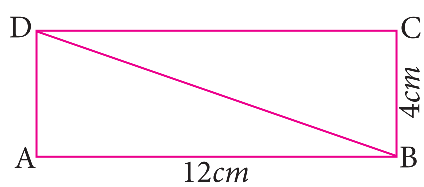
Now, $\quad \text{area} = \frac{1}{2} \times \text{base} \times \text{height}$

i.e., $\quad 50m^2 = \frac{1}{2} \times 20\ m \times h$

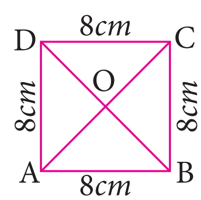
$\therefore \quad h = \frac{50m^2 \times 2}{20m} = 5\ m$

Hence, the other leg of the right triangle is 5 *m*.

Example 16 : (*i*) In the adjoining figure, ABCD is a rectangle with sides 12 *cm* and 4 *cm*. Find the areas of ΔABC and ΔBCD.



(*ii*) In the adjoining figure, ABCD is a square with side 8 cm. Find the areas of triangles OAB. OBC, OCD and ODA.



Solution : (*i*) Clearly, the diagonal BD divides the rectangle ABCD into two triangles ABD and BCD of the same area.

So, area of $\Delta ABD = \frac{1}{2} \times$(area of the rectangle ABCD)

$$= \frac{1}{\cancel{2}} \times (\cancel{12}^{6}\, cm \times 4\, cm) = 24\, cm^2$$

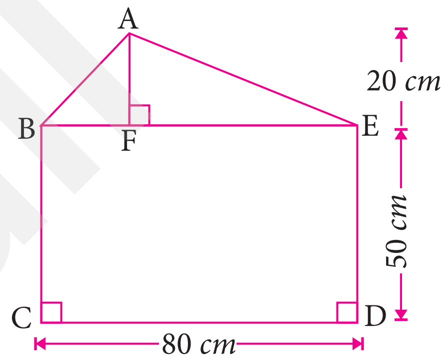
$\therefore$ area of Δ BCD = area of Δ ABD = $24\, cm^2$.

(*ii*) Clearly four triangles OAB, OBC, OCD and ODA each of the same area are formed in the square ABCD.

So, area of ΔOAB = area of ΔOBC = area of ΔOCD = area of ΔODA

$$= \frac{1}{4}\text{(area of the square ABCD)} = \frac{1}{4}(8\, cm)^2 = \frac{1}{\cancel{4}} \times \cancel{64}^{16}\, cm^2 = 16\, cm^2.$$

Example 17 : Find the area of the following figure, whose dimensions are shown.



Solution : Total area of the region ABCDEA

= (area of ΔABE) + (area of rectangle BCDE)

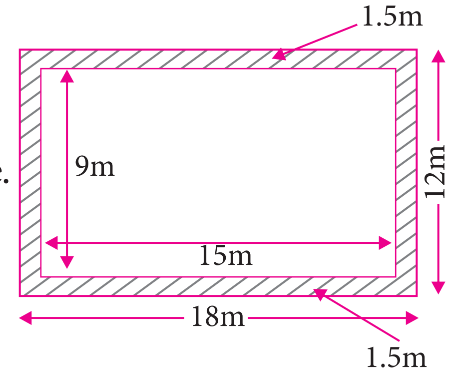
$$= \left(\frac{1}{2} \times BE \times AF\right) + (CD \times DE)$$

$$= \left(\frac{1}{\cancel{2}} \times 80\, cm \times \cancel{20}^{10}\, cm\right) + (80\, cm \times 50\, cm)$$

$= 800\, cm^2 + 4000\, cm^2 = 4800\, cm^2$

Hence, the required area is 4800 sq. *cm*.

Example 18 : Find area of the shaded region of the adjoining figure.

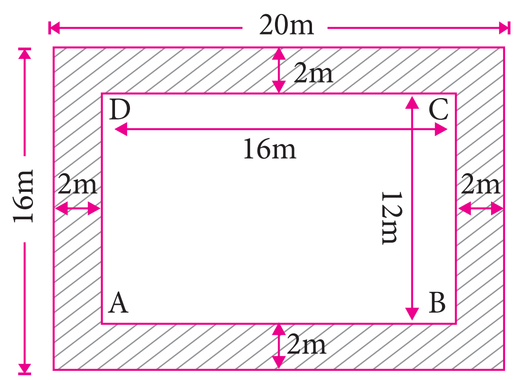


Solution : Area of the shaded region

$= 18 \times 12 - 15 \times 9$

$= 216 - 135 = 81\, m^2$.

Example 19 : A rectangular field is 20*m* long and 16 *m* broad. A lawn is laid in the centre, leaving a 2 *m* broad path all around. Find the area of the inner lawn and the path. The path is to be paved at the rate of ₹20 per square metre. Find the cost of paving the path.



Solution : Length of the filed = 20 m

Breadth of the filed = 16 m

$\therefore$ area of the filed = 20m × 16 m = 320 sq. m

Length of the inner rectangle (AB) = 20 m – 4 m = 16 m

Breadth of the inner rectangle = 16 m – 4 m = 12 m

$\therefore$ area of the inner lawn (rectangle ABCD) = 16 m × 12 m = 192 sq. m

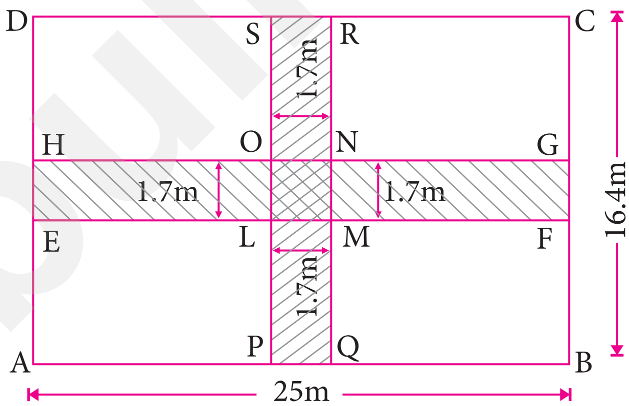
Now, the area of the path = Area of the field - Area of the inner lawn

= 320 sq. m – 192 sq. m = 128 sq. m

Cost of paving 1 sq. m of the path = ₹20

$\therefore$ Cost of paving 128 sq. m of the path = ₹20 × 128 = ₹2,560.

Example 20 : The dimensions of a rectangular field are 25 m and 16.4 m. Two paths run parallel to the sides of the rectangle through the centre of the field. The width of the paths is 1.7 m, respectively. Find the area of the paths.



Solution : In the figure, the rectangle ABCD represents the rectangular field and the rectangles EFGH and PQRS represent the two cross-roads which run at right angles through the centre of the filed.

$\therefore$ Area of the path along the length

i.e., the area of rectangle EFGH = 25 m × 1.7 m = 42. 5 sq. m.

Area of the path along the breadth

i.e., the area of rectangle PQRS = 16.4 m × 1.7 m = 27.88 m^2

Area of the central square

i.e., Area of square LMNO = 1.7 m × 1.7 m = 2.89 m^2

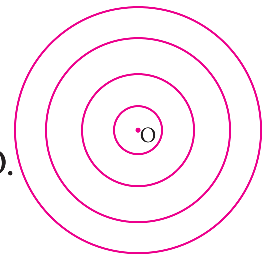
$\therefore$ area of the paths = (42.5 m^2 + 27.88 m^2) – 2.89 m^2

= (70.38 m^2) - 2.89 m^2 = 67.49 m^2

Hence, the area of the paths is 67.49 m^2.

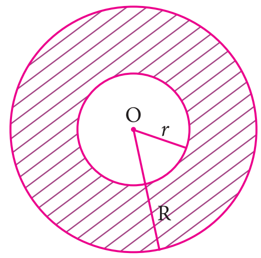
Area between Two Concentric Circles

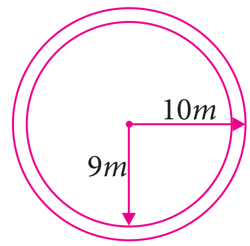
Circles with the same centre are called concentric circles.



The figure given at right shows some concentric circles with the same centre O.

Let us consider two concentric circles with the common centre at O and radii as R and r *i.e.*, C (O, R) and C (O, r).





Example 21 : In the given figure, find the area of the shaded region between concentric circles. (Use $\pi = 3.14$)

Solution : Required area $= \pi(R^2 - r^2) = \pi(10^2 - 9^2)$ $(\because R = 10\text{ m}, r = 9\ m)$

$$= 3.14\,(100 - 81) = 3.14 \times 19 = 59.66\ m^2$$

Example 22 : On a circular cycle lane whose inner radius is 50 m and outer radius is 71 m, soil preparation is to be done at the cost of ₹2 per m^2. Find the expenditure incurred.

Solution : Here, $r = 50\ m$ and $R = 71\ m$.

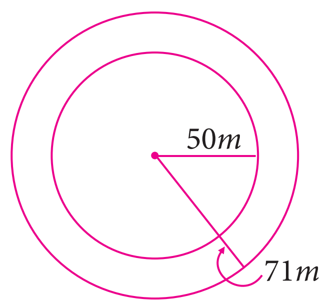
Area of the circular cycle lane

$$= \pi\,(R^2 - r^2) = \frac{22}{7}\,[(71m)^2 - (50m)^2]$$

$$= \frac{22}{7}\,(71m + 50\ m)\,(71m - 50m)$$

$$= \frac{22}{\cancel{7}} \times 121m \times \cancel{21}^{3} m$$

$$= 22 \times 121m \times 3m = 7986 \text{ sq. } m.$$



Now, cost of preparing for area of 1 m^2 = ₹2.

Therefore, cost of preparing for the 7986 m^2 = ₹2 × 7986 = 15972

Hence, the required expenditure is ₹15972.

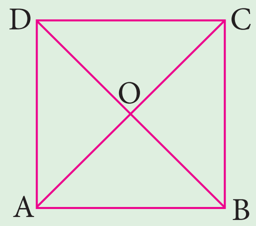
Exercise 11.2

1. Find the altitude of a parallelogram whose area is 2.25 m^2 and base is 250 cm.

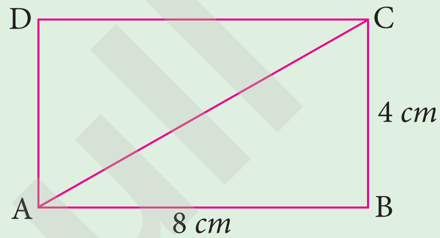
2. Find the cost of levelling a square field with 20.9 m long side at the rate of ₹9 per square metre.

3. Find the area of a square, if its side becomes $\frac{2}{5}$ times of its original length.

4. In the following figure, ABCD is a square and its two diagonals intersect at O. If area of ΔOAB is 4 cm^2, find the side of the square.



5. In the following figure, ABCD is a rectangular with sides 8 cm and 4 cm. Find areas of ΔABC and ΔCDA.



6. The area of a rectangular field is as much as the area of a square whose side is 5.4 m. If the longer side of the rectangular field is 9.0 m, find the breadth of the rectangular field.

7. The diagonals of a rhombus bisect each other at right angles. Use this fact to find the area of the rhombus whose diagonals are of lengths 8 cm and 6 cm.

8. How many tiles of measure 10 $cm \times$ 10 cm are required to cover a surface of 4 $m \times$ 2.5 m ?

9. The area of a triangle is 50 cm^2. If the altitude is of 8 cm, what is the length of its base ?

10. A rectangular field is of 25 m long and 21 m wide. A 2.5 m wide strip is levelled all around it at the rate of ₹5 per square metre. Find the cost of levelling the strip.

HOTS (Higher Order Thinking Skills)

Critical Thinking

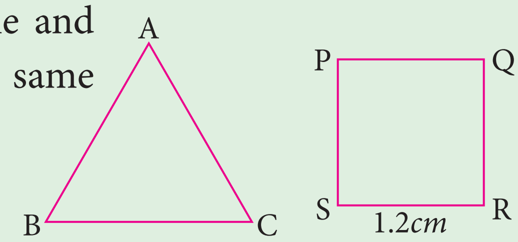
1. A race track is in the form of a ring whose inner circumference is of 396 m and outer circumference is of 440 m . Find the width and area of the track.
2. A circular grassy plot of land of diameter 42 m has a path of wide 3.5 m running around it on the outside. Find the cost of gravelling the path at ₹4 per square metre.

Chapter-end Exercise

Gap Analyzer™

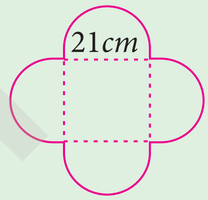
A. Tick (✓) the correct option:

1. In the given figure, ABC is an equilateral triangle and PQRS is a square of side 1.2 *cm*. If both have same perimeter, side of the equilateral triangle is:



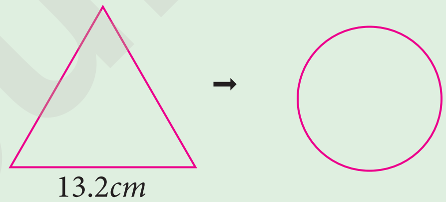
   (*a*) 1.2 *cm* ☐ (*b*) 2.1 *cm* ☐
   (*c*) 1.8 *cm* ☐ (*d*) 1.6 *cm* ☐

2. In the given figure, sides of a square are surrounded by four same semicircles each of radius 10.5 *cm*. The perimeter of the region so formed is:



   (*a*) 132 *cm* ☐ (*b*) 88 *cm* ☐
   (*c*) 120 *cm* ☐ (*d*) 288 *cm* ☐

3. The circumference of a circle is 22 *cm*. Find its area :



   (*a*) 38.5 cm^2 ☐ (*b*) 31.5 cm^2 ☐
   (*c*) 33 cm^2 ☐ (*d*) 30.5 cm^2 ☐

4. One side of a parallelogram is 16 *cm* and the distance of this side from the opposite side is 7.5 *cm*. The area of the parallelogram is:

   (*a*) 100 cm^2 ☐ (*b*) 72 cm^2 ☐ (*c*) 60 cm^2 ☐ (*d*) 120 cm^2 ☐

B. Fill in the Blanks:

Knowledge Application

1. The distance around a circular region is called its ____________ .
2. If the length of a regular octagon is 4 cm, then its perimeter is __________ .
3. The area of circular ring with outer and inner radii 'r_1' and 'r_2' respectively is _____________ .
4. If the side of a square is doubled, then its perimeter becomes __________ times the origional perimeter.
5. If both the height and base of a triangle are halved, then its area becomes ___________ times of the original area.

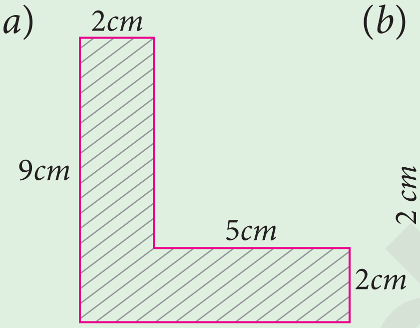
Problem Solving

C. Answer the following questions :

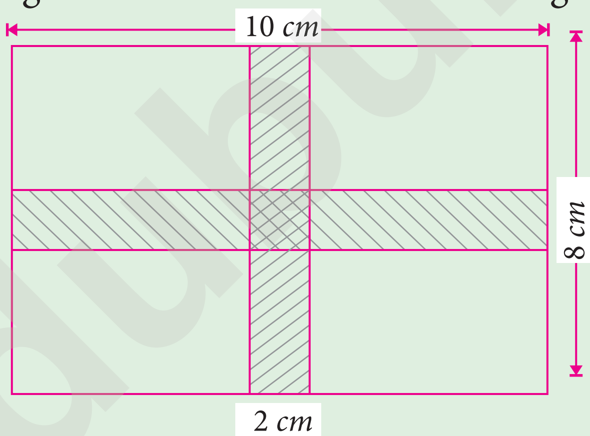
1. The long side of a parallelogram is 8 *cm*. If the shorter side $\frac{3}{4}$ is of the longer side, find the perimeter of the parallelogram.
2. Find the area of a circle, whose radius is :

   (*i*) 2.1 *cm* (*ii*) 4.2 *cm* (*iii*) 6.3 *cm* (*iv*) 7.7 *cm*
3. The ratio of radii of two circles is 2 :3. Find the ratio of their areas.
4. The area of a circle is equal to its circumference. Find its radius.
5. A circular park of radius 8*m* has a path of wide 2*m* running around inside its boundary. Find the cost of paving the path at the rate of ₹18.50 per sq. *m*.
6. A wire bent in the form of a square encloses an area of 121 sq. *cm*. If the same wire is bent in the form of a circle, find the area it enclosed.
7. Find the area of the shaded region shown in each of the following :

   (*a*)



   (*b*)



8. A rectangular field is 20 *m* long and 16 *m* wide. A lawn is laid in the centre leaving a 1.5 *m* broad path all around it. Find the area of the inner lawn.

Mental Maths

Critical Thinking

1. A field is in the form of a triangle. If its area is 2.5 ha and the length of its base is 26 *m*, find its altitude.
2. A wire is looped in the form of a circle of radius 28 *cm*. It is re-bent into a square form. Determine the length of the side of the square.

HOTS (Higher Order Thinking Skills)

Critical Thinking

1. A horse is tied with a rope in the middle of a square-shaped field of side 14 *cm*. The length of the rope is half the size of each side of the field.
   How much area of the field can the horse graze ?
2. The moon is about 384000 *km* from the earth and its path around the earth is nearly circular. Find the circumference of the path travelled by the moon every month in one revolution.
3. A boy is cycling such that the wheel of the cycle are revolving 140 times per minute. If the diameter of the wheel is 60 *cm*, calculate the speed per hour with which the boy is cycling.

Assertion and Reason

Experiential Learning

In each of the following questions, an Assertion (A) and a corresponding Reason (R) supporting it is given.
Study both the statements and state which of the following is correct:
(*a*) Both A and R are true and R is the correct explanation of A.
(*b*) Both A and R are true but R is not the correct explanation of A.
(*c*) A is true but R is false.
(*d*) A is false but R is true.

1. **Assertion (A) :** The area of a triangle = Base × Height.
   Reason (R) : The area of a circle is πr^2.
2. **Assertion (A) :** Perimeter is the distance around a closed figure.
   Reason (R) : To find the cost of putting a lane around a circular table cover, we find the perimeter of the table cover.
3. **Assertion (A) :** The distance around a circular region is called its circumference.
   Reason (R) : If the side of a square is doubled, then its perimeter becomes 4 times the original perimeter.
4. **Assertion (A) :** The measure of the region enclosed by a plane figure is called its area.
   Reason (R) : The perimeters of a square and a rectangle are equal. If their area are A_1 and A_2 respectively, then $A_2 > A_1$.
5. **Assertion (A) :** The lengths of the diagonals of a rhombus are 24 cm and 18 cm respectively. Its area is 216 cm^2.
   Reason (R) : Area of triangle = $\frac{1}{2}$ × base × height.